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MAILING THE ELECTRICAL WORLD.

The present number of The Electrical World will be rolled in its wrapper for mailing, and we hope to hear from our readers as to whether this method is satisfactory to them, it always being our desire to conform to their wishes in matters affecting their convenience.

THE NOVAK LAMP CASE.

The stay granted by Judge Shipman in the Novak lamp suit was somewhat of a surprise and on the face is rather inconsistent with the terms of his opinion. From the remarks, however, of the Judge from the bench it seems that he was impressed with the testimony of the defense in regard to two important claims—the immunity of the Novak lamp from blackening and the manner in which the candle power was maintained uniform throughout the life of the lamp. While in the original opinion these points were given little weight in face of the contention that the use of the bromine vapor was a subterfuge resorted to in order to obtain the benefit of Edison's exhausted receiver, it is probable that when the case again comes before the court more stress will be laid on these points. It certainly seems to be against public policy that a claim for a valuable improvement in an art should not receive full consideration, and be given no weight as against a counter claim which either avoids or admits this improvement. The expeditious manner in which this case has been advanced is a refreshing exception, and only fair toward both parties and particularly the plaintiff, in view of the short term of life remaining for its patent.

PROF. ROWLAND'S CHARGES.

We print elsewhere an account of the charges of Prof. Rowland against the Cataract Construction Company, which are made the basis of a suit against the latter, now on trial before a Federal court. As will be noted, the charges are extremely sweeping in character, and amount to a claim of proprietorship of the ideas contained in the plans finally adopted by the Cataract Construction Company, thus by implication placing Prof. Forbes in the light of a mere adapter of the ideas of others, and this without proper acknowledgement, professional or pecuniary. As the defendant declines to make any statement in advance of the trial in regard to the charges, it would be unfair to accept the ex parte charges of the plaintiff's counsel, given elsewhere, in the absence of further facts bearing on the case, particularly as Prof. Forbes' professional reputation,which has heretofore been irreproachable, is seriously concerned in the issue. The outcome of the trial will be awaited with much interest, as it will also to a great extent dispose one way or the other of the similar charges made recently in England, and at the same time bring out expert testimony and perhaps a technical history of the Niagara plans that will be of great value to the electrical engineering profession at large.

TELEPHONES FOR LOCAL USES.

The expiration on Jan. 30 of the patent on the Bell metallic diaphragm telephone will develop a new field of usefulness for the telephone, and perhaps entirely displace the speaking tube and electric bell annunciator. The cost of telephones for hotels and houses will probably not greatly exceed, if, indeed, they will not be cheaper, than the cost of speaking tubes or an electric annunciator service, while their convenience will be immensely greater. While the mo-

nopoly of the transmitter and switchboard devices will prevent the residents of large cities from obtaining much benefit from the expiration of the patent referred to, farmers and residents of small towns, on the other hand, will obtain full advantage. They will be enabled to run short lines to their stables, places of business, or elsewhere, and in small towns it would seem to be possible to also have exchanges, as the necessary devices will be simple, and can be so selected and used as to avoid switchboard patents. In fact, several such exchange systems are already in a state to put on the market with guarantees that they constitute no infringement on existing patents. There will be no scarcity of instruments when the patent expires, as besides the firms who are preparing for that contingency there are great numbers of telephones made for companies that were afterward declared infringers, and which have been stored to await this opportunity to place them on the market.

THE STREET RAILWAY PRIZE.

If the inquiries we receive are a criterion of the interest taken by electrical inventors in the contest for the $50,000 prize offered by the Metropolitan Traction Company of New York for a system of street railway traction as economical as the trolley, that company will be most abundantly supplied with projects. While thus inventors are presumably responding with alacrity to the demand made upon them, an obligation rests with the company to meet them in a similarly liberal spirit, or at least to give assurance that their labor will receive the consideration that it deserves. If, however, the date first given, March 1, before which a working exhibit must be placed in operation, is adhered to, there is no chance, except under extraordinarily favorable circumstances, for any competition under the terms given. We learn that the Waddell-Entz Company has formally entered the competition with its storage battery system, which has been working so efficiently on the Second Avenue line, but this required no preparation on its part on account of having a practical plant already in operation. We also learn that a system based upon contacts made by means of magnets is preparing to compete, but this also was in experimental shape before the prize was offered. Unless the time of competition is considerably extended these two may be the only systems in shape to compete, and thus no benefit will be derived from impetus given to invention by the offer of the prize. While we believe any suspicion as to ulterior motives on the part of those who offered the prize would be most unjust, yet the discussion over the alleged manner in which the Niagara Construction Company benefited from information obtained in a similar manner would tend to give color to charges by a disappointed inventor based upon the same grounds, if the competition were brought to a close before an opportunity for trial were afforded. We trust that the Metropolitan Traction Company will see the impossibility of accomplishing its purpose within the time limit given, and offer an extension sufficient to enable any inventor who can enlist the necessary support to put his system to a practical test. By so doing it will not only derive the benefit desired but perform a public service of no mean proportions.

MULTIPHASED CURRENTS.

In the section of Laboratory Notes in the present issue Lieut. Patten gives a very clear explanation of multiphased currents and of the rotary field, which will go far toward clearing up the mystery associated in the minds of many with this subject. As pointed out, two or three phased currents are merely ordinary alternating currents, are generated separately as such, and therefore possess no peculiar property in themselves. Owing, however, to the difference in phase, the fields produced by the currents have different values at the same instant, and it is in this alone that the peculiar properties of a multiphased system reside. As regards the rotary field, it is probable that all of its actions can be more easily explained by considering that the poles act alternately on the coils of an armature to induce a current and to produce motion. That is, while one pole or series of similar poles is inducing a current in an armature coil, another set of poles is acting on this coil so as to produce motion, or, in other words, a multiphased motor may be considered as a combination of a transformer and motor, each part alternately discharging one or the other of these functions. This seems to be not only the simplest way of looking at the case, but one from which all of the various phenomena may be most clearly conceived. Whether this is true or not, however, Lieut. Patten shows that mathematics are not necessary to a proper understanding of the subject, which is particularly fortunate in this case, as the mathematical difficulties would be so great otherwise as to debar the great majority of those seeking information on a subject that is daily advancing in importance. As we have remarked before in these columns, the mathematical treatment of alternating currents involves such inherent difficulties as to promise little aid in making investigation having a practical bearing, even at the hands of accomplished mathematicians. It is through methods such as employed by Patten and the graphical methods of Kennelly that the subject can be approached, not only with the greatest ease but with the best promise for practical results. For rigorous proofs and many other purposes a mathematical treatment has its value, but ordinarily it is best to use graphical methods, if not also too involved, and to view the subject from a physical as opposed to a purely mathematical standpoint.

CANDLE POWER OF ARC LAMPS.

Disputes in regard to the candle power of street arc lamps are, judging from our exchanges, of almost daily occurrence throughout the United States, and the opinions offered by experts on one side or the other betray a most unusual ignorance of the subject. In some cases so-called photometric measurements are resorted to, but apparently with no idea as to the proper method by which such measurements should be made or interpreted. The true measure of an arc light is its mean spherical candle power, which involves measurements at different angles in different vertical planes. While the nominal candle power is roughly based upon the candle power of the maximum ray, the position and intensity of this ray may vary widely, depending upon the length of the arc and character of the carbons as well as on the quantity of current, so that no dependence can be placed upon this method for comparative results. Measurements made at the Antwerp Electrical Exposition on 10-ampere, 45.5-volt, 2,000 nominal candle power lamps, gave a maximum candle power of 2,070, a horizontal candle power of 421, and a mean spherical candle power of 750, of which 640 was given out in the lower hemisphere. From this it will be seen that the mean candle power is but little more than one-third that of the maximum ray, while the part of light utilized with street lamps is less than one-third, the difference being radiated in directions above the horizontal. With different carbons, or a different adjustment, the intensity or direction of the maximum ray would have varied, but—and this is the important point—with the same watts the mean candle power would have remained sensibly the same. The practical measure, therefore, of the candle power is the watts used; that is, 2,000 or 1,200 candle power arcs will be produced by 450 or 300 watts respectively; or, as arc lamps are almost invariably adjusted for 45 volts, these figures correspond to 10 and 6.8 amperes, so that for ordinary purposes the measurement finally reselves itself into merely a reading of a standard ammeter in circuit. Even if photometric measurements are made ac-

cording to a proper system, they are likely to have little value on account of the practical difficulties in getting accurate results. Whoever has made such measurements, even in a well equipped laboratory, is aware of the considerable discordance there may be between the readings of different observers, which follows from the great disproportion between the intensity of the arc and that of the usual standards, and the difference in the colors of the lights. Measurements made outside of a laboratory and by untrained observers are therefore unworthy of any confidence, as is almost invariably demonstrated by the absurd results arrived at. The rule to be followed then is, Measure by means of a standard voltmeter the voltage at the terminals of an average arc lamp on a given circuit, and also determine by means of a standard ammeter placed anywhere in the same circuit the current flowing in amperes; if the product of the two numbers thus obtained is equal to or greater than 450 in the case of 2,000 nominal candle power lamps, or 300 in the case of 1,200 nominal candle power lamps, the quantity of light paid for on the basis of these ratings is given out or exceeded.

Tho Novak Lamp Case.

Arguments were made before Judge Shipman in the United States Court at Hartford on Saturday last on the form of the order of the injunction granted the Edison Electric Light Company and the Edison Electric Company of New York against the Waring Electric Company of Manchester. Attorney Dyer, of New York, argued for the plaintiffs and W. E. Simonds and Attorney Morse, of Boston, for the defendants.

The provisions of the order granted by Judge Shipman will allow the Manchester factory to continue operations for a time at least. The principal provisions follow:

The operation of the injunction shall be stayed until the 23d of January, or on such a day thereafter as the Court of Appeals shall first assemble, and that this stay shall then "ipso facto" terminate unless the defendants have perfected their appeal and said case is ready to be called for argument in its due order as a preferred case on the calendar on that day and the defendants then stand ready to argue the same. In which case this stay shall continue until said appeal is decided by the appellate court. The above stay is granted on the condition that the defendants on or before Tuesday, Jan. 16, 1894, file a good and sufficient bond in the sum of $10,000 with satisfactory securities to pay to the complainants any damages or profits to which they may be entitled because of the continuance of the manufacture by the defendants of the lamps alleged to infringe said patents in suit during the period covered by said stay.

The case will come before the United States Circuit Court of Appeals some time during the middle or latter part of February, it is thought.

The Rowland Suit.

A case which promises to be a most interesting one is that of Prof. Henry A. Rowland, of Johns Hopkins University, against the Cataract Construction Company, pending in the United States Circuit Court, for $30,000 claimed by Prof. Rowland for services rendered the Cataract company.

The Cataract Construction Company first employed Prof. Forbes to take charge of the technical work, but also consulted a number of authorities in England and America. Prof. Rowland was employed to make a comprehensive review of all opinions and submit his views. He did so after, as he claims, devoting six months' time to the subject. The result of the opinion and advice submitted by Prof. Rowland was, he affirms, that the Cataract company modified their plans as to the things of which he disapproved, altered them in accordance with his recommendations, and followed his opinions to a large extent.

Prof. Rowland sent in his bill at $10,000. This the company treated as of no importance whatever, and sent him a check for $3,500, saying it was, they thought, enough. Prof. Rowland returned this check and proceeded forthwith to sue the Cataract Construction Company, not only for $10,000, but for $30,000, claiming that he had made the bill too low in the first instance, and that, as he had to sue for his pay, he would claim the full value of his work.

The plaintiff states that the Cataract Construction Company then tendered another $3,500, and offered to submit the whole matter to arbitration, but he declines all overtures of peaceful settlement, and demands that a jury shall say whether he has asked too much. On behalf of Prof. Rowland there will be much expert testimony, including Edison, Sir John Hopkinson, Prof. Barker, Prof. Jacques and others, and we may look for a battle royal of the experts.

The Cataract Construction Company officials declined to make any statement of their side of the case.

Electricity on the Canals.

Superintendent of Canals Edward Hannen, in his annual report, prints without comment the report of Mr. C. R. Barnes, city electrician of Rochester, whom he had engaged as electrical expert for the recent trial of trolley electrical canal propulsion. Two tables are included in the report, giving the result of measurements made, of which the following are the averages:

Average speed.	Amperes.	Volts.	E. H. P.
2.65 miles.....	63.08	294	24.87
4.24 miles.....	63.55	313	26.21

The boat was 98 feet long and equipped with a "dish pan" propeller having a disc of 51 1-2 inches diameter, to which four screw blades were attached. To turn the propeller out of water required 5.35 c. h. p., which should therefore be subtracted from the above figures.

It will be noted that an inordinate amount of power was required and little more to propel the boat at 4.24 miles per hour than at 2.65 miles, which is a discrepancy not easily explained. In deep water it requires more than four times as much power to propel a vessel at the higher speed given over that required for the lower speed, and the power required in the latter case with the boat experimented on would probably not exceed three or four h. p. in deep water.

After the Fair is Over.

Since the first day of the year the grounds of the Exposition have assumed a very unusual aspect. On that date they fell into the hands of the South Park Commissioners and the gates of Jackson Park are once more open free to the public. The buildings are still in the hands of the Exposition company and closed to the public, and will remain so until the exhibits are all removed. But very few exhibits are now remaining besides the foreign ones, and a large number of these have been shipped.

In the Electricity Building practically nothing whatever is left of the American exhibits, and now that the foreign ones are out of bond, there is little delay in removing these. The General Electric Company removed the last of its machinery and vacated its offices some days ago. The Edison tower is now a ruin. Most of the General Electric machinery was returned to the factories, although several machines were sent to a number of different stations. The Westinghouse company has also completely left the building, and all of its large machinery was returned to its factory as well. The Bell Telephone Company has deserted its pavilion. It is expected that within a couple of weeks all of the few foreign exhibits now remaining will be removed.

In Machinery Hall the Westinghouse company, which did not start until very late to remove its big generators, is now

getting them out rapidly. These are also being returned to Pittsburgh to be overhauled. Two of the direct connected engines and dynamos are going from there to Baltimore and two others to Boston.

All of the other electric machinery in the power plant has been removed except the Standard arc dynamo and the two small Westinghouse incandescen machines, which are still in use. Most of the engines are also out, except those driving the dynamos mentioned and also parts of some of the largest ones. A few boilers are still kept. The piping of the plant is nearly all removed, except, of course, that which is in use. This belongs to the Exposition and is being measured up, sorted to sizes and lengths and piled up in the annex to be sold. The wiring is also being removed with rapidity. Work was begun on the wiring in the subway only shortly before the first of the month and is now nearly all removed. The duct wiring of the arc work is also mostly out of the ground. The arc and power wire is the property of the New York Safety Wire and Cable Company, and is to be returned to them. The incandescent wiring belongs to the New York Insulated Wire Company, and is being removed by that firm under direction of the Westinghouse company.

It will be some time before the wiring and lamps can be all returned to their makers. The patrol lights will probably be run until February, but the contracts for the machinery expire on the first of that month.

After the disastrous fire which broke out on the grounds on the night of Jan. 8 the scene at the Exposition presents rather a desolate appearance. The magnificent peristyle, Casino and Music Hall were burned literally to the ground, but the damage done to the Manufactures Building was not as great as at first thought. A number of the exhibits which had not yet been removed were considerably injured by fire and water, and portions of the building, especially parts of the cornices, were destroyed. It is said that the insurance on the buildings had run out.

The Bell Telephone Company.

To an inquirer about Bell Telephone Company earnings the Boston "Transcript" gives the following figures:

	Net income.	Year's increase.	Per cent. gain.
1885	$1,809,996.48	.....	....
1886	1,973,350.76	$163,354.28	9.
1887	2,237,608.12	264,257.36	13.3
1888	2,436,463.56	198,855.44	8.9
1889	2,661,888.69	225,425.13	9.25
1890	2,869,418.35	207,529.66	7.8
1891	3.126,819.90	257,401.55	8.97
1892	3,411,679.78	284,854.88	9.11

It was figured that an increase of 9 per cent. in 1893 would be tantamount to earning some 19 per cent. on the whole $20,000,000 capital, although all of the new stock did not participate in all of the 1893 dividends. Here is another table of interest:

	Surplus earnings applicable to dividends.	Equals on Stock Per cent.
1885	$1,809,996.48	18.09
1886	1,973,350.76	19.73
1887	2,237,608.12	20.8
1888	2,436,463.56	24.25
1889	2,661,888.69	26.72
1890	2,869,418.35	22.95
1891	3,126,819.90	20.85
1892	3,411,674.78	19.49

The following is from a recent compilation of the Boston "Herald":

The present company was organized in May, 1880, with an authorized capital of $10,000,000, and issued capital of $6,500,000. This was increased to $7,350,000 by giving a right to the National Bell Telephone Co.'s shareholders to subscribe for $850,000 stock at par. From that day until recently subscription privileges at par have been issued, and sundry extra and valuable rights have been given to shareholders. None of these is included here. The National Bell Telephone Company had a capital stock of $700,000. When it concluded to reorganize as the American Bell, it sold 500 shares in its treasury for $600 per share to meet its "immediate wants," presumably floating debt. It then gave each shareholder six shares for one and turned the property over to the new company for $6,500,000, taking pay in stock at par. The first year ended Feb. 28, 1880, and included two months of the National Bell year. In 1884 the fiscal year was changed to the calendar year, and covered but ten months. The total dividend payments and capital at the end of each year have been:

	Dividends.	Capital.
1880-'81	$178,500	$7,350,000
1881-'82	416,500	7,350,000
1882-'83	595,000	7,350,000
1883-'84	1,051,479	9,602,000
1884	1,440,315	9,602,000
1885	1,562,236	9,802,100
1886	1,568,336	9,802,100
1887	1,568,336	9,802,100
1888	1,789,878	9,962,100
1889	1,838,913	11,303,900
1890	2,213,913	12,500,000
1891	2,625,000	15,000,000
1892	2,919,080	17,500,000
1893	*3,337,500	20,000,000
Total	$23,106,096	.....
Average per year	1,650,435	11,209,035

*Estimated.

The company began paying extra dividends in 1884. They are included above and in detail have been: 1884, $288,063; 1885, $392,044; 1886, $392,084; 1887, $392,084; 1888, $597,726; 1889, $600,000; 1890, $750,000; 1891, $900,000; 1892, $991,863; 1893, $1,125,000. The average regular and extra dividend per year has been $1,650,435. The average capital has been $11,209,035. The average rate of dividend has been 14.72 per cent.

A Proposed Municipal Electric Lighting Plant.

Paterson, N. J., has recently been giving great attention to the subject of a municipal lighting plant, which is very strongly favored by the Mayor of the city and many of the Council. At a recent meeting of the Board of Aldermen the Mayor made a statement in regard to the probable cost, which is partly in reply to a statement of one John F. Noonan, who said a 600-arc light plant would cost $560,000, and deteriorate 30 per cent. a year.

The Mayor stated that he had received replies to a communication sent to a number of cities owning their own lighting plants asking about the cost per lamp. The mayor of Allegheny replied that his city had $200,000 invested in an electric lighting plant which furnished light for 560 arc and 2,000 incandescent lamps; the cost of operation is about $72 per arc light per year, while Pittsburgh paid $96 by private contract. The capacity of the Allegheny plant is 620 arc and 3,000 incandescent lamps. The Mayor said that there were 125 cities owning their own lighting plants; of these 23 furnish arc lights at a rate of $53.04 per light, while 20 cities whose light was furnished by private contract paid $106.01; it was also stated that Bangor, Me., saved $100 per light per year.

A prominent engineering firm has made a proposition to the city to erect and maintain an electric light plant of the capacity of 800 lights at a total cost of $148,800, divided as follows: dynamos and machinery, $91,800; building, $8,000; poles, lines and construction, $44,000; superintendence, $5,000. It stated that the cost of maintaining the plant for one year would be $34,400, or at the rate of $43 per lamp.

Another estimate was presented offering to erect a plant to furnish 600 arc lights at a cost of $150,000, to be paid for in city bonds bearing interest at 5 per cent., and the parties agreed to run the plant for a year or any portion of the year at the rate of $50 per arc light.

Electric Traction in Cuba.

The first electric tramway in Cuba is projected for the town of Cienfugos. The project is now under consideration by the council of the civil government of Santa Clara.

Electricity in the Far East.—III.

BY W. STUART-SMITH.

THERE are also central stations of considerable magnitude in Yokohama, the Hokkaido (Yezo), Kobe, Nagoya, Kumamoto, Nagasaki, and smaller plants in other cities.

Kumamoto is situated in the island of Kiushiu, and was the centre of what was known as the Satsuma rebellion of a few years ago. The castle was one of the strongest of all the old feudal strongholds in Japan. The old buildings, with one exception, were destroyed by fire during that rebellion, but the walls still remain, with the surrounding moat. New buildings have been erected, and the place is now a military post, one of the most important in Japan. The Kumamoto Electric Light Company was organized primarily to supply light to this post, and the government is still the largest customer, though private demand has necessitated putting in an extra dynamo. The plant now contains two Edison dynamos and one Brush alternator, together making about 1,300 lights, but this number is increased by the fact that many 8-c. p. lamps are used in the small houses.

Including private plants in mills, etc., there are perhaps 75,000 lamps connected, many of which are of 8-candle, this power being better suited to the small stores and house rooms. All these 8-c. p. lamps are 50-52 volts, and on the Edison circuits are connected two in series.

Nearly all the foreign machines in Japan are of American make, there being but very few from European countries.

Most of the Japanese men of war and larger merchant steamers have been built in Europe and are fitted with European electric plants, but two gunboats recently built in Japan have Edison marine dynamos, these having been chosen after the visit of the U. S. S. "Charleston" to Japanese waters.

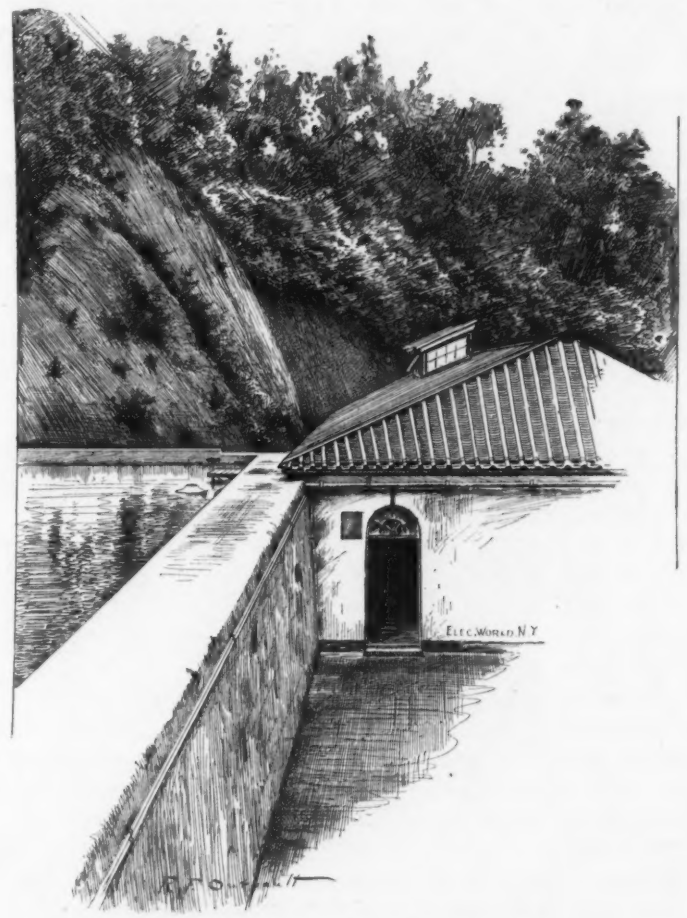
During the big earthquake of two years ago the Yokohama station was badly damaged. Though the centre of the earthquake was two hundred miles from Yokohama, yet the shock there was quite severe. Several earth movements followed each other in regular order, with the result that the big chimney of the electric company swung like an inverted pendulum, the amplitude of the swing increasing with each movement, until finally it broke in the middle and the upper half crashed through the roof. Fortunately it fell in such a manner that only the boiler room was destroyed; the boilers themselves escaped with but slight damage, as they were protected by the base of the chimney. The dynamo room entirely escaped, as did the store rooms, offices, etc. The station stands in the most densely settled part of Yokohama, with houses crowded close against it, and had the chimney fallen in any other direction the loss of life must have been great; as it was, no one was hurt.

WHAT THE CHINESE THINK THEY ARE COMING TO.

The wiseacres of Yokohama, and, especially the daily press, viewed the ruins, and immediately sent up a great guffaw about the engineering of the Japanese. They said "of course the chimney would not stand; it had *hollow* bricks in it instead of being built of good solid material."

Brick chimneys are dangerous on account of the heavy earthquakes frequently experienced. The loss to the Yokohama company was about 10,000 yen, including the cost of a new brick-lined iron chimney 110 feet high by 6 feet in diameter.

As yet there are no electric railways in Japan, though there is much talk of building them, and many efforts have been made, especially by Mr. Fujioka and the Tokyo Electric Light Company, to have the Tokyo tramways electrically equipped. During an industrial exhibition in Tokyo four years ago, the Tokyo Electric Light Company fitted two cars with storage batteries and Sprague motors, and they ran for some time as part of the exhibition, but the good results hoped for were not realized.



CENTRAL STATION AT HONG KONG.

The government owns the telephones and refuses permission for a single trolley system, and, of course, storage battery traction was no more successful than in America.

There has been considerable talk of building electric roads in various parts of the country, mainly with the idea of connecting together separated towns and connecting outlying towns with the steam railroads.

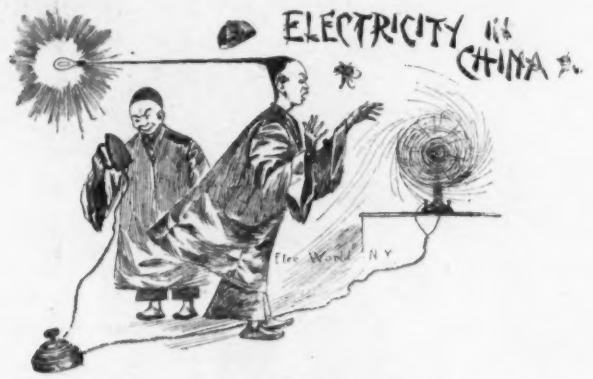
The writer made an estimate for such a road twenty miles long. The gauge was to be 30 inches, and electric locomotives hauling two or three cars were to be used. This same idea was talked of for other places, but after considerable talk had been indulged in the "powers that be" decided that such an arrangement could not be permitted on tramways, that it must be included under the head of railways

and come under the regulations for the government of railways. On this account the enterprises were abandoned, or postponed, until more favorable times. It is certain, however, that several electric roads will be built in the near future. There is abundance of water power in many places, which will surely be utilized for power and lighting purposes.

In mining little has been done toward using electrical machinery, but much has been talked about, and the field for this class of machinery is very promising. Coal mines are very abundant and new deposits are continually being discovered. Copper mines have received considerable development. The largest of these is the Ashiwo mine, and considerable trouble is experienced on account of the acidity of the water, which attacks the pumps, boilers and piping and makes the life very short.

All the telegraph and telephone instruments used in Japan are of native make, nothing of this sort being imported, except an occasional new one to be used as a model to copy. There are several manufacturers of these, the most important being Tanaka & Co., of Tokyo. There are patent laws in Japan, but they are not intended for the protection of the foreigner; on the contrary, Japan is very anxious to be in a position to copy the best that the foreigners devise.

In this, however, they are limited by their mechanical skill, as the finer classes of instruments and machine making are



beyond their powers. They are, however, rapidly improving, and in a few years will be almost entirely independent of foreigners.

Shop keeping in Japan has always been looked down upon, and in the old days the shop keepers were next to the etas, the outcast class of the nation; on the contrary, the man who made something was always esteemed as being a very useful member of the nation, the old sword makers being held in particularly high repute. This same feeling is largely dominant to-day, and it is to this feeling that the large extension of manufacture is due. Engineering is the favorite study of the Japanese youth, and many of them are mathematicians of a high order.

In China but little has been done except in Hong Kong and Shanghai, and even in these cities the work has been a very uphill one, owing to the powerful opposition of the gas companies.

Several years ago a couple of Brush arc dynamos were put up in Shanghai for street lighting, but the company had very hard times. After several years of hard struggle they have finally got in good working condition. Two Mordey alternators have been put in and the service is rapidly extending. The original Brush machines are driven by an old, poorly governed, long stroke, slow speed engine, belted to a countershaft, and the speed varies so much at different parts of the stroke that instruments in circuit plainly show the variation of current. This plant is exclusively used for lighting in the foreign settlement.

An electric road will probably soon be built, extending from Woosung to Shanghai, a distance of about thirteen miles.

In the factories of the Shanghai Cotton Cloth Spinning Mill Company there are two dynamos furnishing current to about 1,200 lamps; one of these dynamos is Edison and the other English (Kapp direct current). This mill stands on the river bank, but there is so much sediment that the water cannot be used for condensing purposes, so settling ponds were built, from which the circulating pumps draw their water. After leaving the condenser the water passes into a ditch, which winds through the fields and finally discharges into the ponds, again having become entirely cooled during its transit.

In Hong Kong the station is furnished with Brush arc dynamos and Kapp alternators.

Many of the offices in Hong Kong are very dark, and pressure is kept on the wires all the twenty-four hours; but few lamps are connected up, and the price is high—two cents per lamp hour. This company has had to fight strong opposition from the gas companies, and shares are very low (as is also the case in Shanghai), but people are beginning to appreciate the advantages. The strong opposition to these two companies, with the consequent slow progress and bad standing, has had considerable effect in preventing the starting of stations in other parts of China and South Asia.

In Manilla a contract has been let for a plant of 10,000 16-c. p. lamps and 250 arc lamps of 2,000-c. p. each for city and private lighting. The city has contracted with the lighting company for 1,000 20-c. p. incandescent lights and 140 arc lights for twenty years, at $60,000 per year. The plan of the city lighting was laid off by the writer.

In Canton there is a small plant, consisting of two 750 light Westinghouse alternators. It has been running about two years without a single accident of any kind. But one dynamo is run, the other being held in reserve. Enough 8-candle lamps are connected up to make the total number of lamps run from one dynamo about one thousand. This loads the dynamo up to its full capacity, and no more can be connected up until the station is extended. Mr. Weise, the engineer, will not run the risk of putting a load on both dynamos, because, in order to keep the good will of the Chinese, it is necessary to have unbroken success; so far, he has had no trouble from lamp extinction, and he is in high repute as being a favorite of the gods, but if he should load both dynamos and an accident should happen to one of them so as to cause the shutting off of part of the lights, his reputation as being a good "Joss" man would be gone, or, at least, would be much weakened. His only assistants are raw Chinamen, to whom he has imparted some instruction. He manages to get along very well now, and trusts the plant to their care after starting up for the night.

Westinghouse engines are used, one for each dynamo, and they contribute largely to the success of the plant, as they require so little care. In fact, Mr. Weise says he could not possibly get along with any other type of engine, as it could not be trusted to his Chinamen. In case of accident to the running dynamo they understand how to start up the other, but at the writer's last visit, last spring, this had never been necessary.

The streets are very narrow (as is the case with all Chinese cities), being from, say, six to twelve feet wide, and are filled with hanging wooden signs. Through these signs the wire must twist and turn, because on no account would the Chinamen allow a sign to be moved to make room for the wire, as it would certainly mean bad luck to their business. In many cases the insulation has been strongly reinforced with rubber and tape, to prevent abrasion from the swinging signs.

The poles are simply cross pieces of timber, with the ends secured in holes cut in two opposite houses. The converters are generally screwed to the wall just inside the buildings and out of reach of people standing on the floor.

The streets of Canton are divided into sections of a few blocks each, and each section is shut off from all others by heavy gates, that are closed at 9 o'clock in the evening. The populace is so turbulent that for many centuries the authorities have made it a practice to hold all the people of any section responsible for any riot or tumult in that section. The result is that the people have got in the habit of regulating affairs in their section without any reference to the powers that be. Mr. Weise had occasion to see the effect of this in an instance where a store wanted lights, but the wires could not be run, because one man objected to having a hole cut in his house for securing a pole. The man wanting lights informed his neighbors, and a delegation waited on the individual and soon induced him to withdraw his objection.

At first there was considerable objection to the plant being put up, but now it has become very popular, and is used in houses and stores; even fruit and nut stands use them in the street, the wires being led from the nearest house. All lamps are on flexible cord, no stationary fixtures being used. The light is now so popular that thousands of lamps could be put in all over the city if the station was large enough to supply them, but its limit is now reached and difficulty is experienced in building a larger one, as the franchise for the entire Canton province is in the hands of one man, and he wants to make too much out of it.

A VIEW OF THE HONG KONG STATION.

The Chinese are great people to expect private commissions on everything they have a hand in, and the management of the company, one and all, manage to steal something. One man, who has the handling of the money, will hold back needed supplies and wages, another, less fortunate, will go to the station and steal coal and oil, and if there is any objection the engineer is told it is none of his affair. In fact, though the plant is a success from an electrical and mechanical point of view, it is kept running under considerable difficulty.

A large station will, nevertheless, be built before long, as there is so strong a demand for it. The charges are very small, being but one-half cent per lamp hour. Attempts are being made to start plants in other parts of the Canton province, and Mr. Weise occasionally makes trips about the country, with a small Edison dynamo and Shipman engine, giving exhibitions, which are sure to lead to the establishment of stations.

In Canton two attempts were made to steal the street wires soon after the station was started, but, unfortunately for the thieves, the wires were alive, and though no one was killed, no attempts have since been made. It is inhabited by a bad Joss, that is too powerful for them.

In Korea there are a few telegraph stations, but the service is under the control of the Chinese. The operators are Koreans of the student class, the members of which have a high standing. They wear hats of a peculiar shape, which no one is allowed to wear who has not passed certain rigid examinations.

Several years ago an Edison plant was put in the palace at Seoul, but with this exception there is no electric lighting in the country. The plant was put in by an engineer who was sent out for the purpose, and the writer's recollection is that he was killed shortly after the plant was finished. Some instructions were given to a Korean who was to act as engineer, but, apparently, he did not become very expert, because soon after being left to himself he burned out the armature, and though there was a spare one, he did not know enough to put it in, and the plant was shut down for a long time.

There is comparatively little money in the country, the common people having none at all. If it becomes known that some one of the common people has saved a little money, the servants of some noble arrest him on some

trumped up charge and he is told that his liberty will be given him when his money is forthcoming. If he is obstinate, he is stripped and whipped daily until he becomes amenable to reason. The Koreans are great believers in the efficacy of the rod, and apply it freely as an antidote for small offenses.

The King, in whose palace the above plant is installed, is a man of large mind and would gladly see his country adopt modern civilization, but Chinese influence is too much for him to surmount.

Alternate Current Working.—II.

BY HARRIS J. RYAN.

THE strength of an alternating current in amperes is numerically equal to that of a continuous current which would cause the same heating effects in thin conductors. Alternating electromotive forces in practical measure are determined by the heating effects of the currents that they establish in thin non-inductive conductors. Consequently, alternating and continuous electromotive forces are identical numerically when the currents that they establish in thin non-conductive conductors produce the same heating effects. The conductor is here specified as non-inductive—one about which the current could not establish a sufficient amount of alternating magnetism to produce an appreciable amount of electromotive force. Electromotive forces thus produced would change the effects of the impressed electromotive force. The conductor is further specified as being thin because in thick conductors carrying alternating currents the current is crowded toward the surface. This effect is caused by the alternating magnetization that the current produces in the interior of the conductor. This magnetization produces electromotive forces that oppose the impressed electromotive force along the interior of the conductor. The current is thus forced to the outer portions of the conductor, with the result that a heavy conductor behaves as though it has a greater resistance for alternating than continuous currents. The rate at which heat is generated in a thin conductor at any instant is equal to $C^2 R$. When R is unity the heat is developed at a rate equal to C^2. The average rate at which heat is developed with an alternating current is equal to the average value of C^2. The strength of an alternating current in amperes, then, equals the square root of the mean of the squares of the instantaneous values of the current in amperes, and is called the effective value of the alternating current. The current established at any given instant through a thin non-inductive conductor is equal to the electromotive force at that instant divided by the resistance of the conductor. The heating effects at any instant equal $C^2 R = \frac{E^2}{R}$. When R is unity these heating effects will equal the square of the electromotive force. The average rate at which heat is produced will be equal to the mean of the square of the instantaneous values of the electromotive force. Consequently, the value of the alternating electromotive force equals the square root of the mean of the squares of the instantaneous values of the electromotive force. This is called the effective value of an alternating electromotive force. The phrase *square root of the mean square* will hereafter be written $\sqrt{mean^2}$. For any particular form of electromotive force or current the $\sqrt{mean^2}$ value may be determined in the following manner: A curve of the squares of ordinates of the curve of electromotive force or current is determined by means of a slide rule, or a table of squares. The area of this curve, obtained by means of a planimeter, divided by the length of the card gives the mean of the squares. The square root of this mean of the squares is the desired effective value of the electromotive force or current. When the maximum value of the curve is taken at unity the $\sqrt{mean^2}$ of the instantaneous values is equal to the ratio of the effective value to the maximum value of the current, or electromotive force. This operation has been done for the electromotive forces given in the foregoing diagrams, and the ratios obtained are as follows: Ratio of effective value to E_{max} for a rectangular E. M. F. curve = 1; for the E. M. F. curve of the Stanley arc alternator = .73; for the E. M. F. curve of sines = .707, and for the triangular E. M. F curve = .58. The product of effective E. M. F. and current in any circuit equals the watts therein displayed. This may be seen more clearly from a study of the following expressions: Average $[E_{inst.} \times C_{inst.}]$ = average watts. $E_{inst.} = C_{inst.} \times k$, where k is the ratio of $\frac{E_{inst.}}{C_{inst.}}$, which is constant at all instants.

$$\text{Average } \frac{E^2_{inst.}}{k} = \text{average watts.}$$

$$\text{Effective E. M. F.} = E = \sqrt{average\ E^2_{inst.}}$$

$$\frac{E^2}{k} = \frac{average\ E^2_{inst.}}{k} = \text{average watts.}$$

$$E = Ck.$$

$$EC = \text{average watts.}$$

Mr. Steinmetz, in the proceedings of the A. I. E. E., Vol. X., page 548, describes a unique method for determining the effective value of an alternating electromotive force, or current, from the instantaneous values. He plots "the instantaneous values of the alternate wave in polar co-ordinates, i. e., as radii corresponding to the time as angle; the area of the curve represents the sum of squares of values, i. e., the effective value, so that the effective value of an alternate wave can be derived directly by measuring the area of the curve of instantaneous values as polar co-ordinates."

The ratios of $\frac{E_{max.}}{M_{max.}}$ were determined for a periodicity of one complete cycle per second. Had they been determined for a periodicity of two complete cycles per second, the ratios would have been doubled, because the areas of the electromotive force cards would have been halved, and the resulting required maximum magnetization halved. The same thing is true of any number of periods per second. It follows then that the product of the periodicity, or number, of complete periods per second into any one of the above ratios will give the ratio of the corresponding maximum electromotive force and maximum magnetization. The electromotive force is multiplied by the number of turns surrounding the alternating magnetization. These facts are condensed into the following expression:

$$\frac{E_{max.}}{M_{max.}} = \rho \sim t, \text{ where}$$

$E_{max.}$ = Maximum value of the E. M. F.

$M_{max.}$ = Maximum value of the magnetization.

ρ = Ratio of maximum E. M. F. to maximum magnetization with a periodicity of unity.

$\sim$ = Periodicity or frequency.

t = Number of turns.

The following values will be introduced in this expression by substitution for the purpose of putting it into the form in which it is much used in practice:

$B_{max.}$ = Maximum magnetic density in the magnetic circuit in lines per square centimetre.

a = The cross section of the magnetic circuit in square centimetres.

$$\frac{E_{\max.}}{B_{\max.}\ a} = \rho \sim t$$

$$B_{\max.} = \frac{E_{\max.}}{a\ \rho \sim t}$$

For the majority of cases in practice the electro-motive force curve has a sine form when $E_{\max.} = 1.4\ E$ and $\rho = 2\ \pi$. Substituting these values in the above expression, and remembering that one volt equals 10^8 C. G. S. units of electromotive force, we have for practical purposes

$$B_{\max.} = \frac{E \times 10^8}{1.4\ \pi\ a \sim t.}$$

The application of this formula is illustrated in the following example: The object is to determine the magnetic flux that must be established through it, and the number of turns that should surround the lug of an alternator armature. The type of armature is similar to that illustrated is Fig. 9:

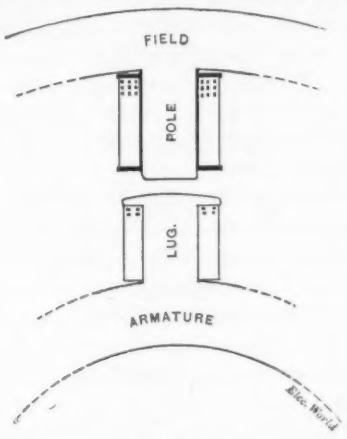


FIG. 9.

The lug is twelve inches long and two inches wide. It passes a north pole one hundred times per second, so that the periodicity of the developed electro-motive force is one hundred. The coil must develop one hundred volt.

$$a = 12 \times 2 \times 2.54^2 = \text{sq. cms.}$$

These values are substituted in the above formula, and we get

$$B_{\max.}\ t = \frac{10^8 \times 10^8}{1.4\ \pi\ 154 \times 100} = 147{,}000.$$

It was determined that undue heating in the iron of the lug would not occur with the use of a magnetic density of $B_{\max.} = 3{,}000$. Therefore, the necessary number of turns in the coil surrounding the lug must be

$$t = \frac{147{,}000}{3{,}000} = 49.$$

(To be continued.)

After-Glow in Exhausted Bulbs.

BY H. M. MARTIN AND W. H. PALMER, JR.

Having failed to note in any communication on the subject of the phosphorescence of exhausted bulbs in a field of high potential and frequency any mention of what, for want of a better name, may be called the "after-glow," we are led to believe that a brief description of this phenomenon may be of general interest.

If an exhausted bulb having a sealed-in electrode be held in the hand and approached to a terminal of an induction coil giving moderately high potential and frequency, the whole interior of the bulb will be permeated by a phosphorescent glow; if, now, the bulb be slowly withdrawn from the field of excitation, the degree of luminosity will gradually diminish till a point is reached beyond which the intensity of the glow, now greatly attenuated, is practically unaffected by any further increase in distance from the terminal. It is this glow, entirely independent for its perpetuation of the field in which the bulb was charged, and continuing, we believe, until electrical equilibrium has been established between the rarefied gas and the electrode of the bulb, that we have called the "after-glow." That it is thus independent of the field of excitation may be proved by shutting off, after the "after-glow" has been established, the exciting current of the induction coil, when the glow will be entirely unaffected and continue, practically, for the same length of time as when the coil is in action. When the glow has become almost imperceptible it may often be stimulated into renewed life by shifting the position of the fingers on the surface of the bulb. After this has been done and the glow has again died away, a single bright flash may be obtained by touching with one finger the projecting end of the sealed-in electrode. That the hand of the experimenter is a factor in these effects may be shown by laying the glowing bulb on a table; the glow, though not extinguished, becomes very faint, especially if no object of capacity be near. The bright flash may still be obtained by again picking up the bulb and discharging as explained. We have repeatedly charged a bulb, shut off the primary current from the coil, carried the bulb to a remote part of the house, laid it on a table, and after picking it up again, obtained a flash on discharging that could be seen some yards away. Lack of apparatus has prevented us from following up these experiments, which are now some months old, but they are valuable, at least, as additional and ocular proof of the electrostatic origin of the "Tesla bulb effects."

Rapid Transit in Boston.

Mayor Mathews, of Boston, in his inaugural address, dwelt particularly upon the subject of rapid transit. Referring to the proposed subway for street railway purposes, he said that action was taken in the belief that a subway could be so constructed under Tremont and connecting streets as to accommodate all the railway tracks now entering that thoroughfare from the south and west; that the patrons of the street railway system could in this way be furnished with quicker transportation and more convenient waiting places than is possible under existing conditions; that the surface of Tremont street should be restored to the exclusive use of foot passengers, carriages and teams forever; that the rentals for the use of the subway would probably be sufficient to cover the interest on bonds to be issued under the act, and to provide a sinking fund for their payment at maturity, and that the State Legislature and the city government of 1894 would be prompt to take such action in the premises as may be necessary to secure these ends. The subway, if built, will be the property of the city, and is to be leased on public account at a rental to be fixed by the board of railroad commissioners.

The mayor said that he would at once appoint, subject to confirmation by the board of aldermen, the three members of the subway commission; and trusted that the character of the gentlemen selected will be taken as a guarantee that this great project will either be carried out in such manner as most to benefit the public and within the appropriations that may be granted in advance, or not at all.

The Reporter's Lot.

City Editor: "The street is all excitement. An electric light wire has blocked traffic, and no one knows whether it is a live wire or not."

Editor: "Detail two reporters to go to the wire immediately—one to feel of it and the other to write up the result."—"New York Weekly."

Problems for Inventors in Incandescent Lighting—II.

BY DR. L. K. BOHM.

THE proper candle power of the lamp is another question to be solved. Opinions as to the most advantageous number of the candles have differed. The 16-c. p. lamp has been regarded as the standard, but some prefer a large and very brilliant light, while others hold that by subdivision of the light a more uniform illumination is effected, since the light is inversely proportional to the square of the distance. Two 8-c. p. lamps give, according to this, a more uniformly illuminated space than one 16-c. p. lamp. Such have been in use for some time, especially in England, but if they are not heated up fully to the required incandescence then these filaments look like red wires, and complaints in this direction were quite frequent. Only slight changes in the voltage bring about very noticeable differences in the candle power with low candle power lamps. The 16-c. p. lamps also lose by continued use, and 32, 50 and 100 c. p. lamps lose the more radidly the higher the candle power is. One hundred candle power lamps, especially on the multiple arc system, lose tremendously after a limited use.

The present generation is accustomed to comfort and luxury. This has been particularly the case with light. If we consider that up to a few decades ago candles and oil lamps were the best means for illumination, and how dim these lights were, and see now the clear lights and their number in our houses, we must come to the conclusion that, regarding light, we have grown more luxurious than in anything else. Therefore, a 16-c. p. lamp will not answer in the future, especially when the lamps do not maintain their original candle power. In my opinion, a 25-c. p. lamp will be the thing of the future, and as high candle power lamps with carbon filaments decrease rather too rapidly in their candle power, we have to look for filaments made of other substances than carbon, or containing at least other substances. There is no doubt that a composition will be discovered from which filaments can be manufactured that maintain their candle power more uniformly than carbon filaments even in lamps of higher candle power.

The vacuum in carefully manufactured lamps is very good; it cannot be improved upon for practical purposes. For scientific investigations, much higher vacua can be produced in single instances. For manufacturing lamps the evacuation may, however, be cheapened by improved devices.

Inventions of the above described character would not be independent, they would constitute only improvements on the Edison lamp and could not be manufactured without the consent of the proprietors of the Edison patent, but as stated above, such inventions would be of lasting value even after the expiration of the fundamental patent, and therefore inventors should work in this direction. The majority of inventors have at present only one object in mind, that is, to produce an independent lamp for the period the fundamental patent runs, and I believe that after the expiration of that patent most of them will return to the all-glass closed chamber, with perhaps one exception, which will be described further down.

Experimenters trying to produce independent lamps have recently been very active. Most of them experimented with cements, by means of which two or more parts constituting the lamp chamber might be joined perfectly air tight, thus avoiding the all-glass closed chamber united by the fusion of the glass. These cements are numerous, some are silicious, some are non-silicious; others are of organic origin: some are composed of organic and inorganic matter. In the patent to W. E. Nickerson and E. E. Cary, Aug. 12, 1893, is described a seal of fusible cement of resin chemically combined with lime. The patent to W. E. Nickerson, Nov. 18, 1893, covers a resinous body made flexible and adhesive by fat, solid at ordinary temperature.

A vitreous composition has been patented by Lodyguine, June 7, 1893. This seal is for the leading-in wires, and is composed of glass or vitreous composition containing a composition of boron. The patent to Paul Scharf of Aug. 20, 1892, describes an incandescent lamp having two tubular bearings metallized, the wires soldered to the metallized bearings of the surfaces and a metallic cap soldered to the outer metallized surfaces of the bearings. Another lamp of Nickerson and Cary (U. S. patent, Sept. 16, 1893) has a plug consisting of two layers, one comparatively hard and infusible, located near the filament, and one comparatively soft and fusible, located upon and outside the hard layer. In the new de Khotinsky lamp a chemically prepared organic compound is employed for uniting a glass cap to the neck.

Some of the above described lamps have been put on the market, but in my opinion none with such success as the lamp possessing the all-glass closed chamber.

The Westinghouse stopper lamp, patents to L. K. Bohm, 1881-1882, consists entirely of glass, but the neck of the lamp and the stopper are ground together. This lamp had originally a hollow stopper, with platinum wires sealed in, while it is made at present with a solid stopper and pretty heavy iron wires. Lamps with heavy iron wires are, in all probability, not all perfectly air tight, but if manufactured as originally patented they certainly will hold the vacuum as well as an all-glass closed chamber united by the fusion of the glass. Some time ago two of these lamps from the old American Company, which were in the possession of a New Brunswick college, were tested and found to be perfectly air tight with a good vacuum in them, although they had been manufactured prior to 1883. This lamp is separable, the stopper can be taken out and the new filaments inserted. As filaments are manufactured very cheaply, this lamp may still have a great future when the processes of exhausting lamps are cheapened, because all the other parts of the lamp can be used over again.

Another field for inventors in incandescent lighting is the electric meter,* but to enter the subject would lead too far for this article.

National Electric Light Association.

The Trunk Line Association has granted the rate of a fare and a third on the certificate plan to Washington and return during the period of the convention, namely, Feb. 27, 28 and March 1. The various other passenger associations have the matter under advisement, and will, in all probability, render their decision in the near future.

Wind Power.

M. de Nansouty suggests that users of wind power might find it an advantage to surround the "atmospheric turbines" by strong towers, for directing the wind by nozzles, as water is lead to a Pelton wheel.

Electric Launches.

An electric boat 150 feet long, 25 feet wide and nine feet deep, with five feet draught, and driven by twin screws, is to be put on Seneca Lake, and is to be used for commercial purposes.

* There is up to date no reliable direct reading electric meter in use.

Is Telephonic Induction Electrostatic or Electromagnetic?

BY F. W. DUNBAR.

THE almost universal verdict has been that the disturbances on telephonic lines known as "cross talk," or "cross induction," are due to the electrostatic induction of one circuit upon another.

Without attempting to review the articles previously published upon this subject, I wish to present the subject in the light of some experimental results obtained by myself some time ago bearing directly upon this question, and hope that more competent mathematicians will take up the discussion and settle in a definite manner a question which may soon have an important bearing upon telephonic transmission.

Whatever the cause of the effect may be, there is little chance for a difference of opinion concerning the effect itself. Whenever a telephonic, or variable, current of any nature is transmitted over one of a number of parallel circuits, whether these circuits be overhead wires or cable conductors, each of the remaining circuits will be disturbed by an induced current of the same nature as the disturbing current. The strength of this induced current is some function of the distance separating the disturbed and disturbing circuits, and decreases with an increase in this distance. The distribution of the current upon the disturbed circuit is governed by the conductivity and capacity of that circuit, as has been so thoroughly pointed out by Mr. J. J. Carty.

These disturbances can be decreased and rendered negligible by making the algebraic sum of the distances between the disturbed and disturbing wires equal to zero—that is, by either spiralling the two conductors of each circuit about each other, as is practiced in cable construction, or by transposing at definite intervals the two conductors of either one or both circuits, as practiced in overhead construction.

This indicates that the disturbance is due to the unsymmetrical relation of the two circuits, but whether it is caused by the electrostatic induction of the one circuit upon the other, due to the variation in potential of the disturbing circuit and varying with the specific inductive capacity of the dielectric, or whether it is caused by the electro-magnetic induction of the one circuit upon the other, due to the variation of the current in the disturbing circuit and varving with the magnetic inductivity of the dielectric, is still an open question.

As it is practically impossible to eliminate the effects of one of these actions without sensibly affecting the other, and as a vast amount of experimental work has been done in this direction with a conclusion in favor of the electrostatic action, I will only attempt to show by data obtained on actual telephone lines and cables the probable magnitude of the two actions.

It is well known that the mutual capacity of the two sides of a circuit is the effective capacity in regard to telephonic or other alternating current transmission. But this statement is far from meaning that this capacity is independent of the capacity "to ground." A more accurate statement of the fact would be that the effective capacitv is the series capacitv "to ground" of each conductor, plus the direct capacitv through the air of the one conductor to the other.

This is shown bv diagram in Fig. 1. Fig. 2 shows the relation when the capacitv of one of the conductors is taken to ground, the other wire being grounded as per practice.

From this we see that the mutual capacitv of one wire upon another must exceed 50 per cent. of either alone to "ground," for the capacity of two similar condensers in series is one-half the capacity of either alone.

Letting a represent the capacity to ground of either conductor alone, and b the direct capacity of the one wire to the other, then in the first case the capacity will be $\frac{a}{2} + b$ and in the second case $a + b$. Thus the mutual capacity exceeds 50 per cent. of either alone to ground by $\frac{b}{2}$.

Figs. 3 and 4 indicate the same conditions with three wires in the field, and in general when a represents the capacity to ground of one of a group of similar conductors and includes the direct, or air, capacity to all other conductors save the one to which its mutual capacity is to be

FIGS. 1, 2, 3 AND 4.

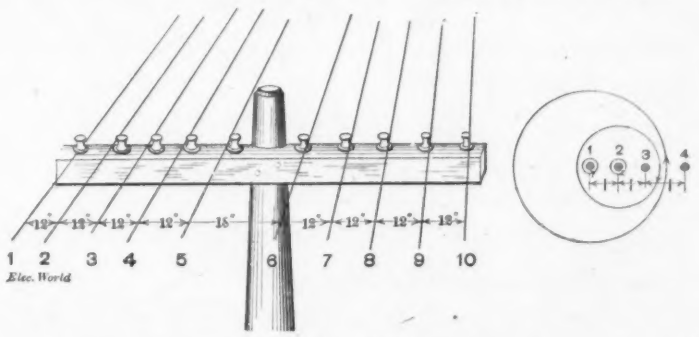
measured, and b represents the direct capacity to this conductor, then the mutual capacity of these two conductors will exceed 50 per cent. of the capacity of either to ground by an amount equal to $\frac{b}{2}$. It is apparent that an increase in the number of wires increases the capacity to ground and the mutual capacity correspondingly.

Below are given the results of some actual measurements made upon existing lines representing the present development of telephonic line construction.

The capacities were taken with all other wires grounded and with the customary ten seconds electrification. The needle was heavy enough to secure the full discharge.

The wires were No. 12 (N. B. S. G.), and their relative positions are shown by Fig. 5.

The results are given in groups of two, for transpositions



FIGS. 5 AND 6.

were present, and the results for each individual wire were really the mean values of two.

TABLE I.

No. of Wire.	Capacity in mfds. per mile.			
	One Wire alone to ground. All others grounded.	One wire to its mate (mutual cap.) All others grounded.	Excess of mutual capacity over 50 pr. ct. of cap. to gr.	Ditto in per cent.
1				11.
2	0.0137	.00840	.00155	
3				6.
4	.0152	.00855	.00095	
5				4.
6	.0154	.00835	.00065	
7				9.
8	.0145	.00855	.00130	
9				13.
10	.0136	.00850	.00170	
Average.	.0145	.00847	.00123	8.5

The above results are the mean results obtained on two sections of line 43.5 and 75 miles in length.

Table II. gives the observed values of the mutual capacity of two wires not necessarily mates, and upon the section 43.5

miles in length. As before the results are the mean values of each group of two:

TABLE II.

No. of wire.	Mutual capacity in mfds. per piece (43.5 m.)		
	Mutual capacity. All others grounded.	Excess over 50 per cent. of the average of each conductor to ground. (Approximately series capacity.)	Ditto in per cent.
1 on 2	0.375	.071	11.
1 on 3	.331	.020	3.
1 on 5	.319	.008	1.
1 on 7	.312	.006	1.
1 on 10	.297	.001	1.6

These results indicate a marked increase in the capacity to ground as we approach the centre of the cross-arm, and a marked decrease in the excess of the mutual capacity over 50 per cent. of the capacity to ground, by the same change.

The increase in the capacity to ground of the wires as they approach the centre of the arm may be partially explained by their closer proximity to the pole and to their more central position in reference to the other wires. But this explains in no degree the decrease in the excess of the mutual capacity of one wire to its mate. The increased separation of 5 and 6 (18") would account for a small portion of this decrease on those particular wires. But we should naturally expect the value of the excess over 50 per cent. to remain constant and equal to $\frac{b}{2}$ (one-half of the direct air capacity of one wire to its mate).

This value of b may be approximately calculated from the formula

$$C = \frac{Area}{4\pi l}\left[1 - \tfrac{1}{2}\left(\frac{1}{R_1} + \frac{1}{R_2}\right) + \dots\right]$$

where l = distance in centimetres and R_1 and R_2 the radia of curvature in centimetres; in this case equal and of opposite sign, thence $c = \frac{\pi\ 0.26}{4\ \pi\ 30} = .0022$ E. S. U. per centimetre.

Reducing to microfarads per mile we have

$$\frac{.0022 \times 10^9 \times 10^6 \times 161{,}000}{(28.8 \times 10^9)^2} = .0043 \text{ microfarads per mile.}$$

and $\frac{b}{2} = .00022$ microfarads, a value but one-third the lowest value obtained experimentally.

We may also readily calculate the approximate increase in capacity due to the influence of the wires themselves.

Thus calling the capacity of a freely suspended wire distant from all other wires a, we have for the capacity to ground of

1, 2, 9 or 10 $(a + 3.2\ b) = (a + .00139)$ microfarads per mile.
3, 4, 7 or 8 $(a + 4.1\ b) = (a + .00176)$ microfarads per mile.
5 or 6 $(a + 4.0\ b) = (a + .00174)$ microfarads per mile.

This only accounts for a small fraction of the increase in capacity, as we approach the centre of the arm

The capacity of a freely suspended wire at a distance of h centimetres above the earth is given by

$$a = \frac{1}{2 \log \frac{4h}{d}}$$

where d is the diameter of the wire in centimetres. For the particular case under discussion

$$a = \frac{1}{2 \log \frac{3{,}600}{.26}} = .0522 \text{ E. S. U. per centimetre.}$$

Reducing to microfarads per mile

$$a = \frac{.0522 \times 10^9 \times 10^6 \times 161{,}000}{(28.8 + 10^9)^2} = .01020 \text{ microfarads per mile;}$$

therefore, neglecting the effect of the cross-arms and poles, we should expect a capacity

for 1, 2, 9 or 10 of .0116 microfarads per mile,
for 3, 4, 7 or 8 of .0120 microfarads per mile,
for 5 or 6 of .0119 microfarads per mile,

the discrepancy is

for 1, 2 9 or 10 .0020 microfarads per mile,
for 3, 4, 7 or 8 .0028 microfarads per mile.
for 5 or 6 .0035 microfarads per mile,

The value of .0035 is certainly a reasonable value for the effect of the poles and cross-arms, but it is scarcely conceivable that this value should decrease to .0020 by approaching the end of the cross-arm; for if the effect were due entirely to the pole the capacity would only be reduced to about .0025 by this change in position, while we know from the constant and controlling position of the cross-arm that the decrease will be far less than that amount.

There is but one obvious explanation of this discrepancy and it also explains the unexpectedly large variation in the excess of the mutual capacity over 50 per cent.

It has many times been noticed that a uniform time of electrification on a line wire is fully as important as in a cable, despite the negligible absorption by the dielectric (air). A reasonable explanation may be advanced when we consider the "bound" charges on the poles and cross-arms.

Owing to the comparatively high resistance of the arms, this charge accumulates slowly, and is especially noticeable on dry cold days, such as prevailed at the date of the tests. For the same reason, the discharge will be retarded, owing to the comparatively slow disappearance of the bound charges on the arms. This would cause an indicated capacity less than the true capacity, and the effect would be greater as the tested wire approached the ends of the cross-arm.

The insulation of the wires themselves frequently exhibit this fact, and Table III. gives the measured insulation of these same wires on one of the dates of test.

TABLE III.

No. of wire.	Insulation in megohms per mile.
1	
2	540
3	
4	360
5	
6	420
7	
8	432
9	
10	570

The error introduced by this partially insulated bound charge will not appear, or rather will be present to a vastly reduced extent, when the mutual capacity of one wire to its mate is measured; for in this case the bound charges are separated by a few inches only and readily recombine, while before they had to traverse a length of cross-arm varying from 5 feet for the end wires, where the error is a maximum, to a few inches on 5 and 6, where the error is a minimum. The pole itself probably causes but little error.

We should then expect that the values of the mutual capacities of one wire on its mate would remain practically constant, increasing slightly toward the centre of the arm, due to the more central position of the wires, and decreasing again on reaching 5 and 6, owing to increased separation.

On examination of the actual values secured, Table I. shows a remarkably close agreement to these values. When, however, we separate the wires whose mutual capacity is to be measured, as in Table II., we see that the effect of the separation of the bound charges again appears, and the apparent mutual capacity decreases slowly with an increasing separation.

(To be continued.)

Laboratory Notes—XIV.

BY LIEUT. F. JARVIS PATTEN.

APPLICATIONS OF MULTIPHASE AND MULTIFREQUENCY CURRENTS.

SOME reference has already been made to what was termed "multifrequency currents" for sake of a proper designation. They will be referred to in general terms as independent currents in the same magnetic system, having different frequencies or time periods. As will be seen later on, they are not without some practical application, and as a study of the action of such currents is best made by a simple system of graphical analysis, they will be considered as a sort of sequel to a brief but similar treatment of the action of multiphase currents, which will serve to familiarize the reader with the method as well as to bring out the salient features of multiphase current applications and the peculiar effect of such currents when applied to a single magnetic system.

Were it not for the rotary field effect, so called, there would probably be little practical use for multiphase currents—but the rotary field effect makes a beautiful motor system possible, that not only dispenses with commutators and brushes, but also one that requires no current in the moving part of the machine, and as such takes a long step, at least so far as the theory of the matter is concerned, in advance of direct current machines, with the difficulties of which we are all so familiar. By the term multiphase currents we understand, in general terms, two or more single alternating currents having different instantaneous current values, but the same period, that is, their successive impulses have the same duration but they do not begin and end at the same instant, one starting a plus impulse, say just about as the plus impulse of the other has attained a maximum value, and is beginning to decline in strength. It is this shifting of the effect of one behind the other that determines the phase difference and gives occasion for the name multiphase currents—both are separate independent alternating currents of the simplest form and are in no wise different from single alternating currents except in their combined effect, or the resultant effect of the two operating together in the same magnetic system. They are referred to as biphase currents when there are only two separate currents, and as triphase currents when there are three used simultaneously. More than three such currents have been used with a view to determining their effect as a further application of multiphase working, but these applications have been very limited, and have served as much as anything to show that biphase or triphase currents can produce as efficient results as would be derivable from the use of many more. It will therefore serve the purpose here to consider the first mentioned only.

In Fig. 32 are shown the curves of two separate alternate currents assumed for convenience to follow a sine function. These curves serve no other purpose than to represent the instantaneous values of the E. M. F. of both at any particular instant of time with reference to each other. The line t_0 t_3 is merely a line of reference, which is taken to represent a certain time interval, during which, as is evident from the figure, one complete wave and a quarter of the current represented by the curve *h h* takes place. Inasmuch, however, as both currents have the same time period continuously, we find that a wave and a quarter of the current has likewise taken place in the same time interval, the only difference between the two currents represented by the two full curves *h h* and *v v* of the figure being that the maxima and minima values of the two currents do not occur at the same instant of time, but these values are displaced by a certain amount with respect to each other, and this amount of displacement, great or small, determines the phase difference between the two currents. In the diagram the curve, or current, *h h*, is at a maximum value when the other is zero and conversely, having the same time period continuously, they must preserve this relation whether the machine generating both goes fast or slow.

Two separate alternating currents having this relation are commonly called biphase currents, and are strictly biphase currents in quadrature, for they might have some other degree of displacement, and they would still be biphase currents, but not necessarily in quadrature, or having ninety degrees phase difference.

As the degree of phase difference has much to do with results, this point of two currents being in quadrature, or having ninety degrees phase difference, will bear a little further elucidation.

Consider for a moment how such a single alternating current as that indicated by the curve *h h* would be produced in the simplest way. Any closed coil, or coil connected through two ring contacts to an external closed circuit, would give two pulsations of current, one positive and one negative, during a single revolution when revolved in a single or two-pole field. Thus, starting at the position where the field has zero induction effect upon the moving coil, we should have an increasing and subsequently decreasing E. M. F., and current in the coil during a half revolution thereof, all in one direction and corresponding to the time elapsed during one-half a revolution, all this E. M. F., or current, being in one direction. In the succeeding half revolution the

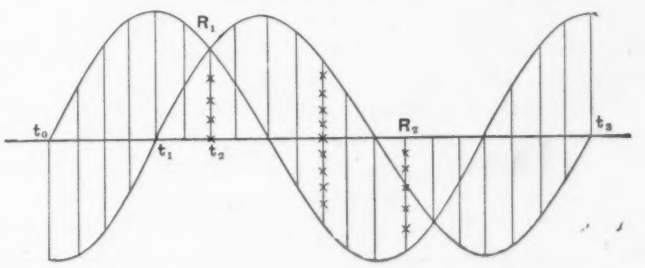


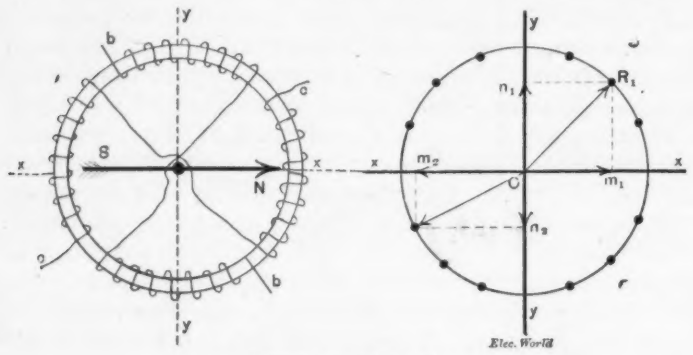
FIG. 32.

same thing would be repeated with the only difference that the E. M. F., or current, would be in the opposite direction; the curve representing this effect during the interval of time elapsed is, therefore, drawn below the time line, or zero line, simply to represent the reverse direction of current flow. Whether the curve representing the current in such a simple case is a true sine curve or not, is immaterial, depending, as it does, upon certain relations of field and coil, it is so represented for convenience and in such form answers the purpose of this explanation. The simplest way then to obtain such a current is to revolve, say, an ordinary Siemens armature, the terminals of which are connected through two rings to a closed external circuit, in a single, or two-pole, magnetic field of constant strength.

If, now, there were another coil identical with the first in every respect, but wound in a plane at right angles to the first and connected through a separate pair of rings to a separate closed external circuit, then this last coil would yield an E. M. F., or current, indicated by the second curve, *v v*, while the first was giving that indicated by *h h*, and these two currents would be properly described as biphase currents in quadrature; but if the two coils were not placed in planes at right angles to each other, their respective currents would not be in quadrature, and would have some other phase difference, depending on the angle of divergence between the planes of their windings; thus we may have biphase currents of any degree of phase difference.

So far as biphase current working is concerned, it will be seen from the analysis given that two currents of different phase cannot give the highest results, unless they have this exact difference of phase and all biphase machines are constructed with this end in view.

As before stated, these two currents, until combined somewhere for a particular magnetic effect, are as separate and distinct as if they belonged to different sources of supply, and their effect in a single magnetic system is easiest considered by so viewing them. In Fig. 33 an iron ring is shown wound with two independent windings, *b b* and *c c*, each occupying a pair of opposite quadrants of the ring. Suppose now the alternating current indicated by the curve *h h* is introduced into this winding, it would produce a fluctuating polarity on the line *X X* of the ring; first, say north polarity at the left and south to the right, this polarity first increasing to a maximum and then declining it would be an instant zero in value; then we should find a south pole at the left and north on the right, which would go through a



FIGS. 33 AND 34.

similar rise and decline in value. Then this cycle would be repeated as long as the current was supplied to this coil. If such a current were supplied to the other coil *c c* of the ring precisely the same thing would take place, with one exception, the polarity would be found on the vertical line *Y Y*, instead of on *X X*, as before. If the current *h h*, or any single current, were supplied at the same time to both coils they would combine as one to produce polarity on lines midway between the vertical and horizontal lines *X X* and *Y Y* depending upon their relative strengths. If, however, one of these windings, say *b b*, were given in the current indicated by the curve *h h*, while the other, *c c*, was at the same time given, the current indicated by the curve *v v* we should find a new and very different effect, for inasmuch as one current is zero, while the other is a maximum, then evidently, while current *h h*, in the winding *b b*, was at its strongest that in the other winding would be zero, and so have no effect, hence, for the instant, the polarity due to *h h*, acting in *b b*, would be at its strongest, and on the line *X X*, correspondingly; a little later the current *v v* being at a maximum and *h h* zero, the polarity would be on *Y Y*, the vertical diameter, and at its strongest in this direction.

At all other times between these two there would be a polarity resulting from the combined action of the two currents lying on some line between *X X* and *Y Y*, and having, as we shall see, the same strength as before, but a different position, and this position of the polar lines shifts or changes, from second to second, to all different positions around the circle, as the two currents, acting simultaneously, vary in relative strength. It is the law of relative change only that keeps the result a constant, and it is only strictly true when several conditions are fulfilled, namely, the two currents must be exactly in quadrature, or be exactly 90 degrees displaced—they must have the same maximum strength and they must be sine-curve currents, or currents that vary as the sine of the angle of displacement of the coil from the zero position, the speed or revolution of the coil being of course assumed constant. When all these conditions are fulfilled, and it is not difficult to have them practically met, we obtain in the ring as a resultant effect of the two currents acting simultaneously a true revolving field—that is, a polarity, the intensity or strength of which remains practically constant, while its direction is constantly changing from point to point around the entire circumference of the ring once during each complete wave of the current or revolution of the generating armature that gives the two currents.

This will be understood from Fig. 34, in conjunction with Fig. 32. In the latter the curves being sine curves the ordinates t_3, R_1, t_4, R_2, etc., indicating the values at the particular moments of the curve *v v*, are proportional to and may be regarded as the sines of the angles of displacement of the coil giving this current. Likewise any ordinate of the curve *h h* is the sine of the angle of displacement from the zero position of this armature. But we have assumed that the coils are always 90 degrees apart by the construction of the apparatus and remembering that the sine of one of these angles, say that made by the armature giving the curve *h h*, is the same as the cosine of an angle of 90 degrees less than that angle, it is plain that the two values of the curves at any instant can be represented properly by the sine and cosine of the same angle. This principle is applied in Fig. 34. Thus at the same instant t_2 both curves *h h* and *v v* have the same ordinates $t_2 R_1$, which means that the polarities are equally strong on both the axes *X X* and *Y Y*, vertical and horizontal. The distances $O M_1$ and $O N_1$ are, therefore, laid off on these co-ordinates, each equal to $t_2 R_1$. Each of these forces is acting independently in these two directions and with the intensities shown by the lengths of the lines laid off, and we know by the principle of the parallelogram of forces that their resultant effect is the diagonal of the parallelogram *O R* (Fig. 34), which must always extend from the centre to the circumference of the circle as long as $O M_1$ and $O N_1$ are respectively the sine and cosine of the same angle, an assumed condition. It is simply another way of stating that as the force or polarity in the direction *O X* decreases, that in the direction *O Y* increases always by a corresponding amount, so that the resultant $O R_1$ of the two in any position is always the same. Thus, if we plot the relative values of the line R_1 (Fig. 32), remembering that they are both negative, we get the values $O M_2$ and $O N_2$ (Fig. 34), the resultant of which is $O R_2$, the same as before; and so we shall find this value or resultant polarity constant all the time under the assumed conditions, the relatively changing currents have in fact no other effect than to shift the direction of the resultant *O R* from point to point around the circle, once for each complete period of current. This is what is known as the rotary field effect, and is in fact the same as if by some extraneous means we caused a north and south polar line to swing with a uniform motion around the circle or ring upon which two windings supplied with such currents are placed.

Manchester Ship Canal.

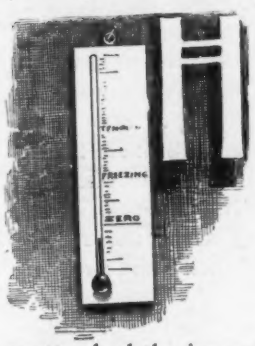
The whole 35 1-2 miles of the Manchester Ship Canal, it is said, will be navigated quite as readily at night as by day, by the aid of electric light.

London vs. New York.

According to a London contemporary, it is stated as a fact that one electric lighting company in New York supplies current to more incandescent lamps than are in use in the whole of London.

A New Method of Preventing Heat Radiation.—II.

BY R. A. FESSENDEN.



OW efficient this means of checking radiation is may be seen from a comparison of curves 3 and 4. In these experiments we see that by simply surrounding the heated box with another one, but 1-4 of an inch from it, we have checked radiation to an extent which could only be accomplished by covering it with a layer of asbestos one and one-quarter inches thick. The ratios between the relative efficiencies would have been still greater had the inner box been blackened.

Placing the outer box has cut down the radiation about 60 per cent., instead of the theoretical over 66 per cent. How much of this effect is due to the insulation of the air we do not know. The insulating power of the air is great when absolutely prevented from moving; according to calculations made by Lord Rayleigh, based on the value for its coefficient of viscosity, its impartivity is .000054. In practice, however, tests give much larger results, probably on account of the impossibility of keeping down diffusion. From the experiments of Professor Ordway, of the Mass. Inst. of Tech., the value obtained in actual experiment is .0008 (in calories). If we accept this value (and the experiments seem to have been made with great care) of the total increase of moratance found on placing the second box about the first, only about 5 per cent. can be due to the resistance of the air, and the theory may possibly be correct. Whatever the reason of the increase of the resistance to the passage of heat, the results show that it is very decided, and that space for space it is much more effective than any other method known. In addition it has the advantage that the specific heat of such a system is very low, which is not the case when insulating materials are used. In the latter case some time elapses before the asbestos or magnesia coating is warmed up, and attains its steady temperature, and the amount of heat necessary to do this is wasted. This becomes important when, as in electrical cooking, the use of the apparatus is only economical on the condition that it is only in use for the actual time necessary to perform the operation required. In the case of the system of polished surfaces, no large amount is required to give the steady temperature, which is attained almost immediately.

In view of the great advantages to be obtained in checking losses from radiation, it is hoped that this method may be of practical use, not only in electrical work, but also in refrigerating work.

The advantage of using polished surfaces may be seen in another way, which does not depend upon any doubtful theory. The emissivity of a substance is defined as the number of calories lost per second per square centimetre per degree centigrade of difference between the surface and the air. Its value for ordinary temperatures in dry air is about .0001 for a surface which is blackened inside but polished outside. The impartivity of asbestos, as given by reduction from Prof. Ordway's experiments, is about .0008, i. e., a cube one centimetre side will transmit .0008 calories of heat per second when the difference of temperature between its faces is one degree centigrade.

If we have a layer of asbestos adjoining and touching a polished surface, and a source of heat on that side of the asbestos which is furthest away from the polished surface, we have the equation

$$.008 \div l \times x = .0001 \times y,$$

where l is the thickness of the layer of asbestos, x is the difference of temperature between the sides of the asbestos, and y the difference of temperature between the polished surface and the air. In order that the drop of heat potentiality may be the same across the asbestos as across the polished surface, we see that the asbestos must be 8 centimetres thick, or, in other words, that the thickness of 8 centimetres is required to produce the same effect as one polished surface.

Below is a table of emissivities drawn from the results of the experiments described above, and also a list of the impartivities of a few substances reduced from Prof. Ordway's results. All are expressed in calories, centimetres and seconds, with the exception of curves 1, 2 and 3, which are in watts and centimetres. It is believed that curves 1, 2 and 3 are quite accurate, on account of the size of the surfaces taken, i. e., six square feet, and on account of the accuracy of the methods used.

TABLE OF HEAT CONDUCTIVITIES.

Calculated from Prof. Ordway's Results.

Loose wool	About .00015
Hair felt	" .00017
Loose lampblack	" .00016
Carbonate of magnesia	" .00022
Fine asbestos	" .0008
Air	" .0008
Sand	" .0010
Best slag wool	" .00022
Paper	" .00025
Asbestos paper wound tight	" .00035

Curve 1 represents the variation of emissivity (in watts) with temperature, of tin polished inside and out. Curve 2, the same for tin polished on the outside and coated with

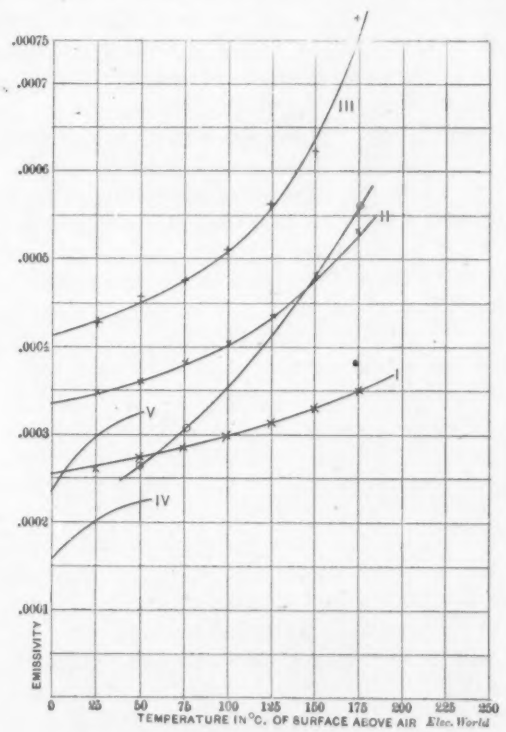


FIG. 2.—CURVES OF EMISSIVITY.

lampblack on the inside. Curve 3, for tin coated both inside and out with lampblack. (The word tin is used in its commercial sense, as meaning tinned iron.)

Curves 5 and 6 are taken for comparison from Everett's C. G. S. units and physical constants, as representing Macfarlane's results for the emissivity, in calories, of polished and blackened copper. The equation given in the book referred to is evidently wrong, and is a horrible example of the effect of fitting equations to curves without taking into account what the general character of the curve must be. It makes the emissivity zero somewhere about 200 degrees C. In the later experiments by Dr. Bottomly, made with the same apparatus, the results give a curve of the same general shape as Nos. 1, 2, and 3. The curve obtained for

the blackened copper ball is given in curve 6. It will be noted that it goes up rather steeply, from which one would suspect an undue amount of convection.

These results are only calculated approximately. In conclusion I would express my thanks to Messrs. Keiper and Fisher for the trouble taken in performing the experiments and in tabulating the results.

Rope Driving.—VI.

BY J. J. FLATHER.

THE subject of rope driving may properly be placed under two heads, according to the nature of the material composing the ropes—whether fibrous or metallic. With few exceptions metallic or wire ropes are used almost exclusively on long distance or telodynamic transmission, while fibrous ropes are employed for intermediate and comparatively short drives. Among the materials used in this method of power transmission we find manilla rope in much favor in this country, as well as in Great Britain and Germany.

In many cases ropes of cotton are also used, as they are generally softer and more pliable than the ordinary manilla ropes, thus allowing smaller pulleys to be used with less injury to the fibres. In fact, cotton ropes of small diameter have been used for years in cotton machinery bandings over pulleys and under conditions which would wear out a manilla rope in one-third the time. There is also an advantage, in that there is less internal chafing and wear when the rope is bent over a pulley, on account of the smoothness of the fibres and the great elasticity of the yarns.

The fibre of cotton is in itself a single cell, or hair, which grows on the coat of the seed and is thus a unit. These fibres are divided into two classes, constituting what is known as the short and long stapled varieties, in which the length varies from 3-8 inch to 1 3-4 inches. The unit cell, when attached to the seed in the plant, is in the form of an elongated cylinder, but when dried and separated from the plant the walls of the cells collapse; the flattening of the cells is not uniform nor continuous in a straight line, and as a result the fibre assumes the appearance of a twisted ribbon of numerous convolutions, somewhat resembling a corkscrew.

The shape of the fibre is thus well adapted to the work of being twisted into yarns and on account of each fibre being a unit its surface is comparatively smooth; the structure of the fibre permits considerable elongation, and especially in the long stapled varieties, the natural wax on its outer surface acts as a lubricant and permits a freedom of motion between the unit fibres without undue wear.

Thus it will be seen that cotton ropes are particularly well adapted to the transmission of power, in which the rope is constantly undergoing a varying strain, and is subjected to much flexion. The strength of cotton ropes is, however, extremely small,* and although the weight is about one-third less than manilla the actual first cost is from 50 to 75 per cent. greater than for the latter. The working strength of cotton transmission rope may be taken higher, in proportion to its ultimate strength, than is used with manilla, for the latter is weakened by the grease with which it is lubricated, and, moreover, a larger factor must be allowed for wear on account of the character of the manilla fibre, which breaks more easily under bending strains.

As compared with manilla, then, the advantages of cotton ropes of the same diameter are: Greater flexibility, greater elasticity, less internal wear and loss of power due to bending the fibres, and the use of smaller pulleys for a given diameter of rope. Its disadvantages are: Greater first cost, lesser strength, and, possibly, a greater loss of power due to pulling the ungreased rope out of the groove—in any case this is very small with speeds over 2,000 feet per minute.

In England manilla is now being used very largely, but cotton ropes were formally preferred to the exclusion of all others for all kinds of driving, but the most probable cause of this was not that cotton was the best or most economical material for the purpose, but that rope driving is most common at cotton factories, and cotton ropes were made in the locality by men who were familiar with the local product and had been for years making spindle and rim bands of small size. When the demand for large sizes arose these rope makers applied themselves to the newer industry and shut out other materials.*

In the mills of Dundee and vicinity, and in the North of Ireland, where flax and hemp are worked, we find ropes of hemp, a local product, used entirely.

Rawhide ropes, which are made from 3-8 inch to 2 inches in diameter, are used to a limited extent. Where the stress in the rope is not great and the accompanying slip is small, rawhide works very well, and will last from three to six, and, in some cases, ten years. Under ordinary circumstances, it is not necessary to use any dressing, as sufficient lubrication is furnished by the rope itself; if the rope slips in its groove the leather will be burned and lose its flexibility and also its adhesive qualities to a certain extent. A rawhide rope has very little tendency to rotate on its axis, and for this reason the wear it not uniform, and with a heavy tension it is liable to take the set of the groove in which it runs; this is rather an advantage for a straight drive, where the rope always runs in the same direction, but in those cases where a rope is led on to the pulleys at an angle this will be a disadvantage, as under such conditions the rope often slips and wear is excessive. Where the rope is subject to wet or dampness, rawhide is an excellent material to use, as it is very little affected by dampness.

The cost of rawhide rope will average about six times that of a good quality of manilla transmission rope.

Solid round and square ropes of leather are sometimes used, and steel ropes with leather washers closely threaded on have been tried with considerable success, but the expense of such a rope would necessarily limit its application.

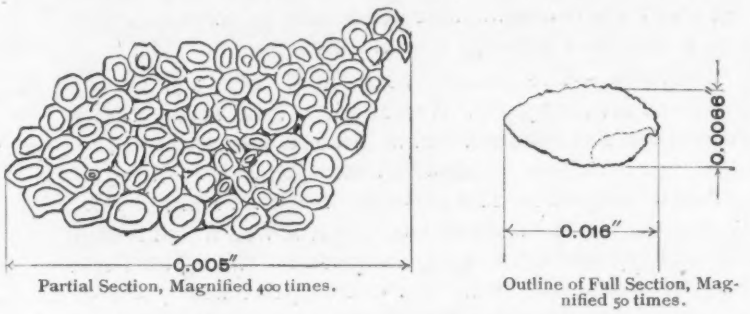
As we have already noted, manilla rope is used very extensively for transmission purposes, but its application has not always met with that success which would follow a more thorough knowledge of its requirements. Inefficient rope drives are erected and run for a few months, or perhaps only days, and are replaced with larger ropes if the sheaves will permit, or, as in many cases, the ropes give way to leather belting and henceforth rope driving is condemned. The true cause is not so much the inefficiency of the ropes as it is the lack of knowledge governing their use and application; in order to obtain a proper conception of this a study of the structure of the rope will be found advantageous. Manilla, or more properly, manilla hemp (abaca) rope, is made from the fibres of the Musa textilis, a plant closely allied to the banana, growing near Manilla, in the Philippine Islands. The fibres are a part of the outer covering of the leaf stalk, which attains a length sometimes as great as 15 feet. To obtain fibres of suitable size for manufacturing rope, the leaf stalks are sub-divided and in the process of segregation the fibre assumes an appearance somewhat similar to that produced in splitting a piece of wood—it is rough and uneven and more or less splintery throughout its length. These fibres, although in themselves not very large, are composed of very fine and much elongated bast cells, which are held together by an intercellular tissue, or mucilaginous substance, which becomes hard when dry.

Fig. 26 represents a portion of the cross-section of a fibre

* Nystrom gives the breaking strength of 3-strand cotton transmission ropes at less than one-tenth that of similar manilla rope.

* W. H. Booth, Am. Machinist, January, 1891.

of manilla magnified 400 times; this section is one of several specimens examined and sketched by the writer and may be taken as a fair average of good manilla similar to that from which transmission rope is made. There appears to be about 400 separate cells in this fibre, which measured 0.0066 inch by 0.016 inch, as shown in the outline view, which is magnified 50 times; lengthwise the cells appear, under the microscope, to be composed of a bundle of tubes glued together, and in places the adhering glue can be seen as a jagged protuberance on the surface, where it was separated from the adjoining fibres. The contour of the perimeter of the fibre is also rough, as noted in figure, as it retains the form impressed upon it by the contiguous cells when in the stem. Moreover, the cells are much shorter than the fibres, and although they taper at the ends there are frequent rough projections where the end laps over, or where a cell is separated from the fibre. These fibres have great strength in the direction of their length, but are weak transversely;* when made into rope they are compelled, in bending over the sheave, to slide on each other while under pressure from the load. This causes the internal chafing and grinding, which, if not prevented, soon wears out a rope when subjected to bending strain.



Partial Section, Magnified 400 times. Outline of Full Section, Magnified 50 times.

FIG. 26.—CROSS-SECTION OF MANILLA FIBRE.

In addition to the action of the fibres upon each other, the strands and the yarns of which the strands are composed also slide a small distance upon each other, causing friction, and hence internal wear.

By opening out an old dry rope which has been used over a sheave, a fine powder will be disclosed, showing that where the rope was bent over the sheaves the strands, in sliding on each other, ground some of the fibres to powder. Another reason for this is that by constant flexure the mucilaginous substance which cements the unit cells into congeries, or bundles, cracks and disintegrates. Aside from the external wear which a rope suffers from contact with its sheave, part of which is the differential driving effect; these two are the principal causes of rapid wear in a rope drive, to remedy which we must in the first case lubricate the fibres, and in the second prevent undue flexure of the rope—how this is effected in practice will be seen presently. In manufacturing rope the fibres are first spun into a yarn, this yarn being twisted in a direction called right hand. From 20 to 80 of these yarns,** depending on the size of the rope, are then put together and twisted in the opposite direction, or left hand, into a strand. Three of these strands for a 3-strand, or four for a 4-strand, rope are then twisted together, the twist being again in the right hand direction. It will be noticed that when the strand is twisted it untwists each of the threads, and when the three strands are twisted together into rope it untwists the strands, but again twists up the threads. It is this opposite twist that keeps the rope in its proper form. When a weight is hung on the end of a rope, the tendency is for the rope to untwist and become longer. In untwisting the rope it will twist the threads up, and the weight will revolve until the strain of the untwisting strands just equals the strain of the threads being twisted tighter. In making a rope it is impossible to make these strains exactly balance each other, and it is this fact that makes it necessary to take out the turns in a new rope—that is, untwist it when it is put at work.

The fibres of manilla which are thus twisted into ropes will average over 6 feet in length, varying from 3 1-2 to 12 feet. If they were long enough the most advantageous method of using them would be to lay the fibres side by side, and secure them at the two ends; each fibre would then bear its own share of the strain, and the strength of the bundle would be that of the sum of the strengths of the separate fibres. As a long rope could not be formed in this way, the ends of the fibres are secured by twisting so as to produce sufficient compression to prevent the fibres from moving upon each other when a strain is applied; but in attaining this amount of compression their strength is greatly reduced; this very compression acts as a constant weight on the fibre and must be deducted therefrom before the available strength can be applied.

The weakening effect produced by twisting varies considerably among the fibres of the same rope according to their distance from the centre or heart of the bundle. If a certain amount of twist be given to a bundle of fibres, the outer ones will be strained more, and will act with less useful effect than those on the inside, which will have to bear the greater part of the strain while the rope is being used. It will therefore be evident that if the fibres were twisted at once into a thick rope the outer fibres would be so much strained as to be of little or no use in contributing to the strength of the rope, but by making the rope as we have indicated by first twisting into yarns, then into strands, and finally combining these into a rope, the strain is more equalized, and the important properties of length and strength are secured without too great a sacrifice of the strength of the individual fibres.

The degree of twist in the rope may be determined by constructing a right-angled triangle, the base of which is the circumference, and the height the length of one turn of the strand measured parallel to the axis. The difference between this height and the hypotenuse is the quantity by which the rope is twisted. The ropemaker's ordinary rule for a three-strand rope is to have one turn to as many inches as are contained in the circumference of the rope; but the degree of twist is variable and more or less dependent upon the judgment of the maker.

Experiments by Reaumur to determine the effect of twist upon a rope showed that a small well-made hemp cord broke in different places with a mean weight of 65 pounds; while the three strands of which it was composed bore 29 1-2, 33 1-2 and 35 pounds respectively, so that the total absolute strength of the strands was 98 pounds, although the average real strength was only 65 pounds, thus showing a loss of strength of 33 per cent.

More recently the test of a small rope showed an average strength of 4,550 pounds, while the aggregate strength of its 72 yarns was 6,480 pounds—each yarn bearing about 90 pounds; thus there is a loss of 1,930 pounds, or about 30 per cent.

(To be continued.)

* The tensile strength of manilla fibres will average over 30,000 pounds per square inch of section.

** A three-strand rope, one inch in diameter, is the key to the sizing of the yarns. Yarns of 20s are of such a size as to require 20 to fill a tube half an inch in diameter, or to make one strand of an inch rope; 26s requires 26 to fill the same size tube and so on.

City and South London Railway Company.

The traffic receipts for the week ending Dec. 17, 1893, are given as £905, which is a decrease of £13 compared with the corresponding period of last year, while the receipts from the end of June were £20,037, which is an increase of £143 over those for the corresponding period of last year.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS.

BY CARL HERING.

ELECTRO-PHYSICS.

Explanation of the Ferranti Phenomenon.—The "Elek. Zeit.," Dec. 29, abstracts a paper by Dr. Sahulka, of Austria. If the secondary of a transformer is connected to a capacity which is not too great, the ratio of transformation increases and may become greater than that of the windings, while at the same time the primary voltage becomes greater and the primary current smaller; this, he states, is the most curious of the Ferranti phenomena, and he explains it by showing, first, theoretically, and then experimentally, that it is due to the so-called magnetic leakage; the mathematical principle in the abstract is hardly conclusive, as it is not sufficiently complete; in the experimental investigation the transformer was constructed with a cylindrical core, with one coil in the middle and one at the ends; by using the two end ones as primary and the middle as secondary or vice versa, the leakage could be made very small or very great respectively; in the former case the condenser increased the voltage only 1.5 per cent., while in the latter the increase was 18 per cent.; he concludes from this that there is no doubt that if all the magnetic lines generated by the primary cut the secondary, and vice versa, there will be no Ferranti effect.

Duration of a Discharge.—According to the Lond. "Elec. Rev.," Dec. 29, Mr. Mayer estimates that with a striking distance of 8 centimetres, the duration of a single flash from a Holtz machine is less than one-millionth of a second; with shorter distances the flashes are formed of several separate sparks; with a large inductorium, a distance of one millimetre and a Leyden jar of 242 square centimetres surface in circuit, the discharge lasts one-twenty-fourth of a second and is formed of over 720 separate sparks; the latter decreases with increased distances up to between 1 and 2 centimetres, when it is reduced to a single flash.

Dielectrics in Rotating Electric Fields.—In the Digest, July 15, under "Electrostatic Hysteresis," an article by Mr. Arno was abstracted. In the Lond. "Elec.," Dec. 29, an article supplemental to this is abstracted, giving the numerical results of experiments for the values of the constant $\mathfrak{H}$, by which the field intensity raised to the 1.6 power must be multiplied to obtain the energy dissipated; this formula is analogous to the Steinmetz formula for magnetic hysteresis, and the results confirm the supposition that the work done in this case is due to electrostatic hysteresis.

Tesla's Researches.—The "Zeit. feur Elek.," Dec. 15, reprints a portion of an address by Prof. Ettingshausen, in which he gives a short description of the life and works of his countryman, Nikola Tesla.

Oscillations in Cylindrical Conductors.—The mathematical article of Mr. Blondin is continued in "La Lum. Elec.," Dec. 23.

Impedance of Mutually Inductive Circuits.—Mr. Rimington's article, mentioned in the Digest last week, is concluded in the Lond. "Elec. Rev.," Dec. 29.

Calculating Alternating Currents.—The article by Mr. Guilbert on a discussion of Mr. Steinmetz's method, is concluded in "La Lum. Elec.," Dec. 23; the method, it is claimed, is not new, but leads to very interesting results.

Conductivity of Flames and Gases.—The Lond. "Elec. Eng.," Dec. 29, abstracts a short article on this subject, showing that there is considerable conduction in some flames and that it increases with the temperature.

Electricity.—The Lond. "Elec. Eng." Dec. 29, contains the sixth article by Mr. Walker on "What Is Electricity"? Attractions and repulsions of bodies are discussed.

MAGNETISM.

Pull of Magnets.—The serial in "Ind. and Iron," by J. S., is continued in the issue of Dec. 22; it is well worth reading; but scarcely admits of being abstracted. Taking an electromagnet coil of 100 turns and one ampere, with poles of 1 square centimetre and a keeper of 1 centimetre distant, neglecting leakage and assuming a uniform field, he calculates the field in the air gap by multiplying the ampere turns by $0.4\,\pi$ lines and dividing by the air gap, giving 62.8 miles per square centimetre; suppose the keeper be allowed to move toward the magnet 1 millimetre, the induction will be 68.7; neglecting hysteresis and Foucault currents, if the coil had been short-circuited at first there would have been an induction current due to 62.8 lines cutting it; if this is done after the movement of 1 millimetre there will evidently be more work done on the circuit; some work has also been done in moving the armature, therefore when a magnet does work on an armature the source of energy has to supply more energy than is needed for the moving of the armature, the surplus being obtainable by short-circuiting the coil. He then discusses, without the use of mathematics, the stored energy, and compares it to water running out of a cistern in which the height diminishes as the water flows out; if the cistern had an outlet of such a shape that the rate of escape of water was proportional to its height, it would follow exactly the same law as the magnet; the work stored in the coil of an electromagnet can be found by finding the power at the beginning of the dying away, taking this as continuing until the field is gone and dividing the result by two; the resistance of the coil cancels out; if it is high, the field dies away quicker but develops a greater power for shorter time.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Capacity of Condensers for Alternating Currents.—The "Elek. Zeit.," Dec. 29, abstracts a paper by Dr. Sahulka, of Austria, in which he shows that the capacity of condensers with solid dielectrics is smaller when used with alternating currents than when measured with continuous currents; the dielectric takes up some energy, part of which is again returned at discharge; for this reason the capacity measured with a continuous current source will be too great both for charging and for discharging, as in either case the quantity passing through the galvanometer will be larger than that due to the true capacity; with alternating currents there is not sufficient time to take up the energy as with continuous currents, and for the same reason less is given out at discharge; for alternating currents the capacity should therefore have a special definition, for which he suggests the re-

ciprocal value of the product of $2\ \pi n$ and its inductive resistance, the latter being the quotient of the difference of potential and the current at charging; with a condenser of 1 microfarad, in which paraffine paper was used, the difference was 14 per cent. less for alternating currents; his results also agree approximately with the law of Steinmetz that the work consumed in a condenser is within wide limits proportional to the square of the voltage.

Copper Electrolysis in Vacuo.—The Lond. "Elec.," Dec 29, reprints in abstract a Royal Society paper by Mr. Gannon; a summary of the experimental results is as follows: For neutral solutions of copper sulphate the copper deposit is higher, other conditions being the same, if the voltmeter is under reduced pressure, but the percentage difference is not constant; it is constant and higher than 1 if a little free sulphuric acid is added to the solution under atmospheric pressure; if the acid is added to both, the percentage difference will also be constant; for current densities of over 0.01 ampere per square centimetre of active cathode, there is practically no difference between the two deposits; if the current density is below this, the deposit in vacuo is appreciably higher; for different current densities the curve of deposits is more regular for those in vacuo while below a density of 0.01 it is approximately a straight line. In a paper by Prof. Schuster immediately following this he gives the results of experiments which prove that nearly the whole effect which is observed when copper is immersed in a solution of sulphate of copper or sulphuric acid is due to the presence of oxygen in these solutions.

Resistances and Conductivities of Metals and Alloys at 0° C.—The Lond. "Elec.," Dec. 29, gives a table of lines of different lengths representing the volume specific resistances and conductivities for various metals and alloys based on the determinations of Profs. Dewar and Fleming.

Resistance of the Earth.—"L'Ind. Elec.," Dec. 25, states that Mr. Kallmann has measured the resistance of the earth at Berlin, using about 50 amperes, and finds it to be equal to a mean of $1 \div 3{,}600$ ohm per metre, if the two contacts form perfect connections with both the water and the gas pipes; when connected to only the water pipes it was $1 \div 2{,}500$.

Measuring the Efficiency of Dynamos.—The Bul. de la Soc. Belge. Elec.," for June-July, reprints an article by Mr. Bouquet, from "Genie Civil" of October, in which the Swinburne method is described and followed by another, which is claimed to eliminate completely errors inherent in this method and does not neglect any quantities, thus giving a closer approximation. Owing to typographical errors and the omission of important diagrams, the description is not clear, and therefore those interested should refer to the original.

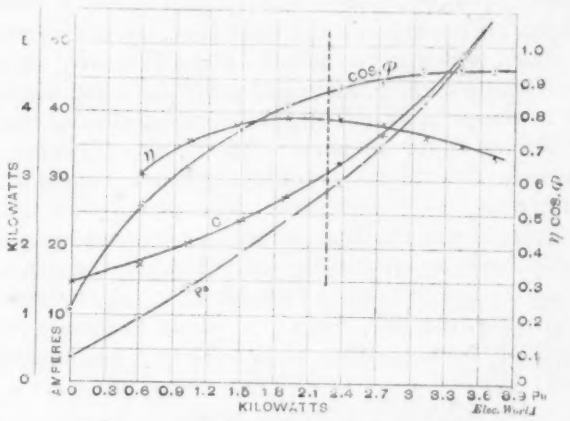
Measurements at Central Stations.—The serial by Dr. Kallmann is concluded in the "Elek. Zeit.," Dec. 29; in it he discusses measurements of currents, resistances and insulation and the construction of instruments based apparently on his differential method.

Dynamometry.—In the serial by Mr. Carter in the Lond. "Elec.," Dec. 29, he discusses the measurements of work and power.

Hookham Meter.—The Lond. "Elec.," Dec. 29, gives a very well illustrated description of the present form of this well-known meter, which differs greatly in detail but not in principle from the old form; its construction is simple and robust.

DYNAMOS AND MOTORS.

Experiments with Brown Non-synchronous Motors.—"L'Ind. Elec.," Dec. 25, gives the results of a series of very complete tests made by Mr. Banti in Rome, with a number of Brown motors installed there; three motors were tested of 3, 1 1-2 and 3-4 h. p.; tables and curves are given, of which the curves for the 3-h. p. motor are reproduced here in the adjoining figure; *Pe* represents the electrical h. p., *Pu* the useful, or brake, h. p., *C* the current cos Φ the cosine of the angle of lag between the current and potential, and *eff.* the commercial efficiency in per cent. The weights of the three motors, including the pulleys, are 418, 264 and 154 pounds, respectively, and the number of poles were 6, 4 and 4, respectively. The experiments show, among other things, that the current, when the motor is not loaded, varies between 1-2 and 1-3 of that at full load, but the apparent power is then 3 to 5 times greater than the true power; also



TEST CURVES OF 3-H. P. MOTOR.

that the commercial efficiency of the 3-h. p. motor at full charge is 78 per cent.; no figures are given regarding the starting, that is, between the instant of closing the circuit to the times when synchronism is reached, which is greatly to be regretted. (The article is headed "Non-Synchronous," while the table is headed "Synchronous," but we assume that the first is what is meant and that the motors are probably those described and illustrated in the Digest Sept. 25 and discussed in subsequent abstracts.)

Iron in Armatures.—The "Elek. Zeit.", Dec. 29, contains another article of the series by Mr. Schultz, the present one being on an investigation of the supposed advantages of insulating the iron discs from each other, and on the effect of the thickness of the discs. He constructed four armatures, two with thin plates of 0.5 millimetre (19.69 mils) and two with plates 1 millimetre thick (39.37 mils), in one of each pair the plates were insulated from each other with paper, as usual, while in the other there was no such insulation; the external dimensions of the armature core were the same in all; these were revolved in a field, being driven by an electric motor; the power required for each could be measured accurately; the results of the tests and calculations are given in detail, allowances being made for the different cross-sections of the iron; applying Steinmetz's formula for the loss in a cubic centimetre of iron per period, he comes to the following important conclusions: For armatures, with or without paper, the Foucault currents appear to be quite the same, being even 20 per cent. greater when paper is used; the use of paper, therefore, is absolutely unnecessary; the thickness of the plates has a very important effect on the magnetic losses, the coefficient in connection with the Foucault current factor in that formula being five times as great for the thick plates as the thin ones, that is, the loss due to Foucault currents is five times as great; the rise in temperature of an armature will depend on these losses. In the conclusions he quotes from a former paper (see Digest Aug. 12), in which these conclusions were confirmed by temperature measurements; with or without paper the results were the same, but with the thick plates the rise of temperature during a 2 1-2

hours run was 42 degrees, while with thin ones it was 48 degrees C.

Irregularities in the Action of Dynamos.—Mr. Montpelier in "L'Elec.," Dec. 23, classifies the irregularities in the behavior of dynamos, showing in each case what test to make and what to do in order to correct the faults as quickly as possible.

Unipolar and Non-polar Induction.—A translation of the article mentioned in the Digest Jan. 6 is given in abstract in the Lond. "Elec. Eng.," Dec. 29, in which the illustrations are reproduced.

TRANSFORMERS.

Air-Core Transformers.—Referring to an article on this subject abstracted in the Digest Nov. 25, Mr. Shand, of Lynn, Mass., writes to the Lond. "Elec.," Dec. 29, showing that the phenomenon of increased impedance and decreased current in the primary circuit, observed on closing the secondary circuit under certain conditions, was observed four years ago in the laboratory of Prof. Elihu Thomson; the following experiment was made: The primary of a small Ruhmkorff coil was put in series with nine lamps in multiple and excited with an alternating current; when the secondary circuit was closed through a Geissler tube, or conductor, of high resistance, the lamps fell perceptibly in candle power, showing that the impedance of the primary was apparently increased; when the secondary was closed through a low resistance the lamps brightened as usual.

ARC AND INCANDESCENT LIGHTS.

Photometry of Projectors.—"La Lum. Elec.," Dec. 23, contains an article by Mr. Fery, in which he discusses the question of whether the law of inverse square does, or does not, apply; theoretically, if the rays are parallel it does not, while in practice it does if the objective of the source is taken as the real source. He discusses the case of a lens with the source in back of it, and shows that up to a certain point in front of the lens (the conjugate focus) the rays converge, and this point should be considered as the source; for a crater 5 millimetres in diameter and a lens 1 metre in diameter and 1.5-metre focal distance, this point will be 300 metres distant; the ratio of the intensities with and without the lens will be the proportion of the surface of the lens to that of the crater, which he calls the multiplying factor, and which in the case of the projector at the World's Fair was 90,000; it is a mistake, however, to do as they did at Chicago, to multiply this by the intensity at 1 metre from the arc; by placing the photometer at the lens the intensity would be that of the arc divided by the square of the distance to the lens, which in the case cited gives 1,333 candles in place of 3,000, which it would be if this correction were neglected. He describes a series of experiments which, he states, conform to the theory; the calculated and observed intensities given agree more or less approximately, although their difference is in some cases over 100 per cent.; up to the point mentioned above the intensity is assumed constant, and beyond that the inverse square law is assumed to apply, "taking the lens as the origin of distances." (This statement is probably a typographical error, judging from what preceded.) All that was said about lenses is applicable in the same way to mirrors. The description and several cuts showing the curve of intensities are not as clear as might be desired.

Flashing. — In discussing the suit in this country, the Lond. "Elec. Rev.," Dec. 29, states that a very significant reason for using this process is that the time required to remove the occluded gases during exhaustion is very much less when the filaments have been flashed.

Frosted and Colored Bulbs.—London "Electricity," Dec. 29, contains an article on this subject by Mr. Wirt, in which he describes several methods of frosting and coloring.

Cored Carbon Litigation.—The "Elek. Zeit.," Dec. 29, contains a lengthy communication on this subject.

Franklin's Electric Light.—According to the "Elek. Rundschau," No. 6, an apparatus has lately been discovered in London with which Benjamin Franklin produced an electric light sufficient to read by; the generator was a large glass cylinder rubbed by a brush and the discharge took place between a knob and a point.

TRANSMISSION OF POWER.

Transmission of Power at Niagara Falls.—Prof. Forbes, in a communication to the Lond. "Elec. Eng.," Dec. 29, replies to several criticisms, in which he endeavors to show that there is not the slightest foundation for certain charges which were made; he also defends the action of the company regarding the acceptance and rejection of designs. An abstract of the second day's discussion is given in the Lond. "Elec. Rev.," Dec. 29; the same journal contains a long editorial on this subject; it criticises the action of the company in entrusting the plant to a professor instead of to men having long experience in actual work; regarding artificial loading for parallel coupling, it states that no practical engineer of this day would think of employing such a clumsy device; there are several plans in daily use that are far better; regarding low frequency it states that it does not enable synchronizing motors to be either cheaply or easily made for starting, nor does it affect in any way the parallel working, nor is there the slightest advantage for transforming or for motors; it is emphatically denied that Mordey's alternators do not work perfectly in parallel; belief is expressed that the best frequency for general work is about 60, and that electricians must sooner or later adopt this as one uniform frequency. The same journal also contains a communication from Mr. Mordey regarding the synchronizing power of his alternators; the experiment alluded to by Prof. Forbes was the placing between the two machines of a resistance considerably more than was required to absorb the whole output of one of them; as even under these conditions the machines did not actually break out of step, Mr. Mordey regards the experiment as very satisfactory and as affording a very strong proof of the powerful synchronizing effort.

Transmission of Water-Power.—According to the Lond. "Elec. Eng.," Dec. 29, plans are being made for the transmission of a water power of 12,000 h. p. in Southern India to two towns requiring a line 110 miles in length and to be used for lighting and power purposes; alternating currents are to be used. It mentions another proposed installation in Southern Russia, in which 5,000 h. p. are to be transmitted ninety-three miles.

ELECTRIC RAILWAYS.

Disturbances Produced by Railway Currents.—The "Zeit. fuer Elek.," Dec. 15, publishes the rules, the compliance with which is required by the Austrian Government Telegraph Department in the construction of electric railways, to avoid interference with telegraph and other delicate instruments.

Conduit Road in Budapest.—According to the "Elek. Zeit.," Dec. 29, the present horse lines in that city are to be gradually replaced within three years by the electric conduit road at present in use; the increase will be about forty-two miles; this leaves little doubt that this road is successful.

Railway in Japan.—According to "La Lum. Elec.," Dec. 23, an electric railway is projected in Japan between two cities forty-eight miles apart, the source of power being a waterfall; another project is for a road fifteen miles long, also operated by water power.

Bordeaux Railway.—"L' Ind. Elec.," Dec. 25, contains an illustrated description of the third overhead line in France, which is erected by the T. H. Co.

Lauterbrunnen-Muerren.— "La Nature," Dec. 23, publishes a well illustrated description of this road, together with a plan and profile.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Charging for Electricity.—In London "Lightning," Dec. 28, Mr. Madgen discusses the subject and describes the method of Mr. Wright adopted by the Brighton Corporation; it considers that the maximum current taken by the consumer at any time indicates the proportion of capital at the station; for which he is responsible for this maximum rate, for several hours a day, he pays a certain charge, and for any consumption beyond this he pays only half that rate. For this purpose a maximum indicator is required, which is described and illustrated in the article; it consists essentially of a U tube ending at the top in two sealed bulbs, one of which is surrounded by a coil in series with the mains, which warns it, causing the liquid to overflow into the other bulb, where it is retained; the column shortened by the amount which has overflowed indicates the maximum current that has passed; it is reset by tilting the tube.

Operating Costs.—In the "Elek. Zeit.," Dec. 29, a detailed report is given of a station in Vienna, in which accumulators are used, the cost for different items is given in detail and does not admit of being abstracted; regarding the accumulators it may be said that their mean efficiency in watt hours was, for the whole year, 83.1 per cent. as compared with 77 per cent. of the previous year; of all the current generated 54.8 per cent. went into the accumulators.

Low Frequency Currents.—Commenting on the article of Lieut. Patten, in The Electrical World, Dec. 2, the Lond. "Elec. Rev.," Dec. 29, states that the application of the device for obtaining currents of low frequency is ingenious and novel, and opens a field well worth further investigation, but that it is not easy to see in what way currents of this kind have any special therapeutic value.

Three-phase System.—The "Elek. Rundschau," No. 6, publishes the first part of an article on the three-phase current, in which are given the formulas for making calculations in such a system.

Accumulator Regulator.—Mr. Leroy, in "L'Elec.," Dec. 23, describes an apparatus for operating the accumulator switches used in large central stations.

Search Light in Shaft Sinking.—"Electricity," Dec. 29, describes briefly this application of search lights in a shaft in Scotland.

Central Stations in Great Britain.—The Lond. "Elec. Rev.," Dec. 29, prints as a supplement a complete list of these stations, with a short description of each.

London.—In "L'Elec.," Dec. 23, Mr. Haubtman continues his serial on electric lighting in London, describing the stations of the Metropolitan Company; the illustrations include two large folded plates.

Cologne.—In the Lond. "Elec.," Dec. 29, Mr. Crompton replies to the article mentioned in the Digest last week, showing that the figures, although very good, do not compare well with those of Bradford or Liverpool.

Blackpool.—London "Electricity," Dec. 22, gives an illustrated description of this station.

Chatsworth.—The English papers give an illustrated description of a small plant at Chatsworth.

WIRES, WIRING AND CONDUITS.

Resistances with Alternating Currents.—In "L'Ind. Elec.," Dec. 25, E. H. (Mr. Hospitalier) makes some interesting and practical deductions from an inaugural address made by Sir William Thomson as president of the Institution of Electrical Engineers in 1889; these deductions simplify very greatly such calculations. Assuming circular wires, the resistance to alternating currents will be equal to that for direct currents, multiplied by a factor k, which depends on the frequency and on the diameter; this factor is the same if the product of the frequency and the square of the diameter are the same; on this basis he has calculated the following table, in which the first column represents the frequency in periods per second, multiplied by the square of the diameter in centimetres, for copper having a resistivity of 1,597 C. G. S. units; for any frequency and diameter of wire calculate the figure in the first column, then the corresponding one in the second will be the factor by which the ohmic resistance must be multiplied to obtain the resistance for these alternating currents:

$d^2 f$	k	$d^2 f$	k
0	1.0000	1620	1.8628
20	1.0009	2000	2.0430
80	1.0001	2420	2.2190
180	1.0258	2880	2.3937
320	1.0805	5120	3.0956
500	1.1747	8000	3.7940
720	1.3180	18000	5.5732
980	1.4920	32000	7.3250
1280	1.6778		

If the product of the square of the diameter, multiplied by the frequency, is greater than 32,000, the effective resistance may be obtained with considerable precision in assuming it to be equal to that of a tubular conductor of the same external diameter and a thickness equal to $6.38\sqrt{T}$ in centimetres, T being the time of one period. For a different specific resistance the numbers in the first column of the table should be changed in proportion to the ratio of the resistivities, that is, as $1{,}597 \div r$, in which r is the resistivity of the other metal; the magnetic permeability, however, must remain equal to 1; these formulas do not take into consideration a capacity nor mutual induction. A translation of the article is given in the Lond. "Elec. Eng.," Dec. 29.

Safety Cables for Mines.—The "Bul. de la Soc. Belge. Elec.," for June-July (just received), contains a description by Mr. Masson of the Cockerill-Jaspar cables, which are claimed to avoid the danger of igniting fire-damp in case of short circuits, faults, etc.; he states having witnessed experiments in which the cables were crushed and cut, the current being broken without the least spark.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Theory of the Shunted Condenser in Automatic Telegraphy.—In the Lond. "Elec. Rev.," Dec. 29, Mr. Taylor gives a non-mathematical explanation of the increasing speed when this apparatus is placed in series with a receiver; for high speeds of working he shows that a high E. M. F. should be used, but unless some additional means are adopted, it would produce a great deal too much magnetic induction. The action of the condenser is to bring the resistance shunting the condenser automatically into the circuit soon after the commencement of each current; during discharge the condenser acts not only as a short circuit of this resistance, but as an additional battery joined in series with the other; the common statement that the charge and discharge of the condenser overcome, or neutralizes, the back E. M. F. and extra current of the receiver coils, he states, is misleading.

Transatlantic Telephony.—According to the Lond. "Elec. Eng.," Dec. 29, an attempt was made on Dec. 28 to telephone from St. Martin's-le-Grand to New York, but it was unsuccessful; no further information is given.

Pacific Cable.—The London journals of Dec. 29 reprint a report of Mr. Sandford Fleming on the proposed routes, in which is included a table of the estimated earnings.

Field Telegraphy.—A translation of the article mentioned in the Digest Sept. 23 is given in "L'Elec.," Dec. 23, including the illustrations.

Sweden, Norway and Denmark.—Telegraph statistics for the year 1892 and telephone statistics for Sweden are given in the "Jour. Telegraphique," Dec. 25.

Telephone Statistics in Austria.—Some statistics for the year 1892 are given in the "Zeit fuer Elek.," Dec. 15.

ELECTRO-CHEMISTRY.

Electrolytic Separation at Definite Voltages.—The Lond. "Elec. Rev.," Dec. 29, abstracts an article by Mr. Frendenburg, in which he classifies metals into three groups; those which are not separable, those which are precipitated as peroxides and those appearing in the metallic state on the cathode; the voltage has little influence in the separation of these three groups, but applies chiefly to the separation of the members of the third group; the latter is considered in detail, the proper voltage suitable in each case being given in the original.

Electrolyzers.—The Richardson & Andreoli apparatus are described and illustrated in "La Lum. Elec.," Dec. 23, in the former the granulated material to be treated is carried on a moving belt below an inverted vessel, in which the gases are collected, and which contains the carbon anodes. In the Andreoli apparatus the liquids are made to circulate between numerous vertical plates.

Electrolysis of Fused Salts.—Mr. Andreoli's article is continued in "Ind. and Iron," Dec. 29; he discusses the electrolysis of strontium, lithium, sodium, potassium, chlorates and chlorides, many of the descriptions being chiefly of historical interest.

Pollak Accumulator.—The "Elek. Rundschau," No. 6, publishes a short description of these well-known cells without, however, giving anything not already published.

Silver Plating Industry.—The serial in "Ind. and Iron" is continued in the issue of Dec. 29, in which the subject of wires is discussed.

MISCELLANEOUS.

Electro-Culture.—According to the "Zeit. fuer Elek.," Dec. 15, Mr. William Siemens experimented with the effect of electric light on plants and found the following: The electric light (presumably the arc) acts equally beneficially on the formation of chlorophyl as on the growth of the plants; the plants need no rest during the twenty-four hours, but make greater progress if they are exposed to the sun during the day and the electric light during the night; the electric light increases the development of flowers and fruits, the flowers being more intensely colored and the fruits having a finer odor and aroma; the cost of the light is but slight, if natural forces are at one's disposal.

Electricity of the Skin.—According to London "Electricity," Dec. 29, Prof. Yarchanoff experimented by connecting electrodes applied to the skin at various parts of the body through a galvanometer, "and at such times the various stimuli of the skin—such as light tickling with a brush, heat, cold, a needle prick, sound, light, taste and smell—were noticed, and in all cases a strong deflection of the galvanometre needle was observed. Merely opening the eyes after having had them closed for some time produced a considerable deflection, and mental efforts, like calculation, also had a similar effect." He believes that the source may be due to the decomposition of metals taken in the food.

Electric Light in Surgery.—According to London "Electricity," Dec. 22, it has been noticed that when the eyes are illuminated from behind by an incandescent lamp placed in the mouth, the pupils, seen as blood red apertures, do not contract, a fact which may make this application an important one.

Electric Welding.—In a well-illustrated article in "La Lum. Elec.," Dec. 23, Mr. Richard illustrates and describes a number of apparatus, among them the Lemp regulators, the Suppes method for welding rails, the Angell & Burton multiple system, the Coffin system of the revolving arc, the Mountain system of radiation from the arc, the Krupp arc system and the soldering iron of Tinnerholm.

Some Opinions Regarding the New Form.

A DECIDED IMPROVEMENT.
Philadelphia, Pa. W. W. GIBBS,
President Electric Storage Company.

I LIKE THE NEW FORM MUCH BETTER; it is a beauty.
Philadelphia, Pa. W. W. HESS, "The Car."

MORE BENEFICIAL to the trade and to advertisers.
Philadelphia, Pa. HENRY R. CUTTER,
Cutter Electric Manufacturing Company.

A GREAT IMPROVEMENT. Our advertisement looks well, and we are hoping for a good many inquiries from it.
New York. HINE & ROBERTSON.

IN TYPOGRAPHICAL APPEARANCE the magazine cannot be excelled, and the size is more convenient for perusal.
Washington, D. C. STORY B. LADD.

WAS NEAT in its old dress, but in its present form no other journal compares with it.
E. B. SEELEY.

THE CHANGE IN THE SIZE of The World was a move in the right direction and a good thing for all concerned.
J. G. BIDDLE, Queen & Co.

THE NEW FORM of The Electrical World will have more readers, and hence be more valuable to advertisers.
FRANK McINTIRE, W. C. McIntire & Co.

THE IMPROVEMENT, general appearance and usefulness of The Electrical World in its present condition cannot be questioned by any intelligent man."
E. WARD WILKENS, Partrick & Carter.

WE HAVE NO HESITATION in saying that the new form will meet with general approval.
C. F. LUNKENHEIMER,
Vice-Pres. The Lunkenheimer Company.

THE NEW FORM of The Electrical World is a decided improvement from the point of view of the reader.
Madison, Wis. Prof. D. C. JACKSON,
University of Wisconsin.

I AM VERY MUCH PLEASED with the change. It is far more convenient both for the desk and on the shelves than previously.
Cleveland, Ohio. E. P. ROBERTS.

IN ITS VASTLY IMPROVED SIZE and appearance The Electrical World is now in an eminently practical form. Another good innovation is the page of professional cards.
New York, N. Y. EDWARD T. BIRDSALL.

I CONGRATULATE YOU upon the new form of The World and feel assured that it will meet with the general approval of your readers.
New York, N. Y. E. W. LITTLE,
Interior Conduit and Ins. Company.

A GREAT IMPROVEMENT over the old form, and even should the circulation be no larger, the paper is certainly more convenient and will give more satisfaction to the public in general.
New Haven, Conn. C. D. WARNER,
Standard Electric Time Co.

I LIKE THE NEW FORM you have adopted, as I believe it places the matter in a more compact shape and will make a better size for binding purposes. I am pleased with our advertisement, as it appears in this issue, and wish to thank you for the excellent taste you always display in arranging our matter.
Hartford, Conn. F. G. WATERHOUSE,
Waterhouse, Gamble & Co.

WHAT I THINK of The Electrical World in its present form and condition is the fact that I have this day signed contracts for two advertisement in it, which is the first advertising we have done with this paper for three years.
New York, N. Y. C. J. FIELD,
Field Engineering Company.

I LIKE THE NEW WORLD very much, and think you have made a big hit in reducing the size. Certainly the electrical fraternity will appreciate it and it should (as I have no doubt

it could) continue to receive their hearty and undivided support. Trusting your labors will be crowned with that success which they merit, I remain, etc.,

Boston, Mass. WILLIAM N. TITUS,
President Northwestern Land and Coal Company.

I AM GLAD to see that alternating currents are to be treated by Prof. Ryan, so that the ordinary man can grasp the subject and get some idea of them.

New York, N. Y. CHARLES E. CHAPIN.

A GREAT IMPROVEMENT. We have the new Electrical World and we like the size and get up of it much better, and consider it a great improvement on the old form.

St. Louis, Mo. J. A. J. SHULTZ,
President Shultz Belting Company.

I WISH TO CONGRATULATE YOU on the appearance of the first number of The Electrical World in its new form. It is a very handsome and impressive publication, and I am confident you will never regret the change of shape.

New York, N. Y. DAVID WILLIAMS,
"Iron Age."

THE NEW APPEARANCE of The Electrical World is a great improvement. The paper is concise, to the point, and covers a field more general than any of the other papers we are aware of. With kind wishes for the new year, we remain,

New York, N. Y. JEROME KIDDER MFG. COMPANY.

AFTER READING YOUR TELEPHONE EDITORIAL we wish there were more papers like The Electrical World. Most of the others seem afraid to speak. We enclose herewith our advertisement and wish we could send you a larger one, for you deserve it.

Mianus, Conn. PALMER BROTHERS.

WE AWAITED the issuance of this paper with great interest, and certainly could not help being pleased with it. We hear nothing but complimentary remarks regarding this magnificent issue on all sides. Wishing you continued success, etc.

New York, N. Y. FRANK S. DE RONDE,
The Standard Paint Company.

THE NEW SIZE of The Electrical World is much more convenient than the old one, the reading matter is, as it always has been, arranged with great care and the advertisements make a business-like impression. Of course we will continue our advertisement.

Newark, N. J. LOUIS HECK,
Stucky & Heck Electrical Manufacturing Company.

I AM VERY MUCH PLEASED with the new size of The Electrical World. The reading contents of the paper are certainly much more attractive and get-at-able. Our "ad" is excellent evidence of the versability of The Electrical World staff. Altogether I congratulate you upon the change.

Chicago, Ill. WM. H. McKINLOCK,
President Metropolitan Electric Company.

A GREAT ADVANCE, both in appearance and in convenience, and certainly reflects great credit on you for progressive ideas and a disposition to keep in the front rank of electric journalism. Wishing you continued success and compliments of the new year, we remain,

THE EMERSON ELECTRIC MANUFACTURING COMPANY,
H. L. PARKER, President.

IT WILL ENHANCE THE VALUE of the journal as one to keep on file for future reference, many fold. The advertisements have generally, if not always, been improved by the new setting, and I esteem it a very great gain in my own case that the advertisements of engineers are brought together into a group.

Vineland, N. J. WM. A. ANTHONY.

WE SINCERELY CONGRATULATE you on the improved size and shape of The Electrical World. It is very compact, both for reading and filing, as we think everybody will certainly want to do on account of the valuable scientific information it contains. Wishing you the success your energy merits.

New York, N. Y R. EDWARDS,
Edwards & Co.

MY PERSONAL CONGRATULATIONS on the new form of your paper. It is a great improvement in every way and will make The Electrical World more popular than ever. It is much more convenient to handle when reading, cuts up the advertising space better (not getting so much matter on a page), and the printing and arrangement of the cuts are excellent.

Brooklyn, N. Y. J. REMSEN BENNETT,
The E. W. Bliss Company.

YOU HAVE ADVANCED ANOTHER STEP in the general improvement of the journal and the contents of it are in such a get-at-able order that it becomes a pleasure to refer to any particular article or advertisement between its covers. We are much pleased with the appearance of our own advertisement, and only trust that times will so improve as to permit us to feel justified in increasing our space.

Philadelphia, Pa. HARRY S. SMITH & CO., LTD.

I MUST CONGRATULATE YOU on the handsome issue of The Electrical World of the 6th of January; also the interesting reading matter contained therein. The new size and appearance is a great improvement over last year's issues. The advertisement we have inserted on page 20 maks a very nice display, and undoubtedly will lead to many valuable inquiries, etc.

New York, N. Y. EDWARD B. WYMAN,
Central Electric Heating Company.

THE ELECTRICAL REVIEW would prefer to congratulate its enterprising contemporary, but candor compels us to state that we do not believe the change to be a happy one. High class publications, such as "Harper's," "Leslie's," "Scientific American," "Western Electrician," "American Machinist," and the "Electrical Review," have won pronounced and recognized success in the field just deserted by The World. So sensitive is the public in all things that concern its reading and advertising patronage, that an abrupt change, unless a conspicuous advance, is seldom greeted with favor.

—The Electrical Review.

ALTHOUGH SOMEWHAT BELATED, the last issue of The Electrical World—the first in the new form of reduced pages—was of conspicuous excellence and one reflecting credit on all taking part in the work of producing it. The World in its new shape was awaited with much interest by the electrical fraternity, and the expressions of praise were many and cordial. The "Western Electrician" extends its congratulations on the 100-page issue. An interesting feature of the paper was a comparison of the advertisements published in The World, "Engineer" and "Review," much to the advantage of the first named.

—Western Electrician.

THE NEW ISSUE of The Electrical World, dated Jan. 6, is the start of the twentieth year in this progressive paper. There is a change in size, bringing it down to a more readable form, while the paper is much thicker in volume. The first number promises great things for the future. It is replete with illustrations. Some idea of the field which has been covered by the weekly digest of electrical literature may be had from the fact that in the past eleven months since it was started there were published in this department over 2,000 abstracts and references, which required the careful reading of over 800 issues of journals, of which about two-thirds were in foreign languages. The subscription of this paper is low, and, owing to the more convenient form, it will gain even more patrons than it now has. The Electrical World, in an editorial, gives a comparison between 1883 and 1894. The most conclusive argument showing popularity with the trade is the advertising patronage. The number of advertisements in the pioneer issue of 1883 was 63, and they occupied 430 inches of space, while in this issue the number is 320 advertisements, and they occupy 2,549 inches of space, a gain in eleven years of over 500 per cent.

—N. Y. Times.

Why He Does Not Like It.

In response to your inquiry of Jan. 6 asking me how I like The Electrical World in its new form, I wish to say I do not like it for the following reasons:

The paper it is printed on is too good for regular use. Now, for instance, I am in the shop, and my hands are oily and dirty, and it is so clean and smooth I dare not touch it. If it were on common paper I would have no such scruples.

In the second place, I placed my card in the advertising column, and now it takes me half my time to answer the inquiries it brought, so I have to work harder, and I do not like hard work.

In the third place, there is too much to the paper; it has so many interesting things in it that it takes all my spare time to digest its contents, and consequently I have no time to read the other journals that come to my office.

Also, I do not like it for the reason that by its growing corpulency it denotes prosperity to its owners, and as I am of a jealous disposition and like not my fellow man, nor to see any one make money unless I am making more than they are, I naturally do not like it, and I know there are a good many others who do not like it for this same reason.

Excuse my being so very candid in my criticism, but as you asked for my opinion I have given it in an honest, straightforward manner and trust you will not take offence at my plain speaking.

New York, Jan. 9, 1894. FRANK M. ASHLEY.

An Automatic Warehouse Telephone.

A new warehouse telephone has just been placed upon the market by the well-known telephone and electrical manufacturing firm of T. W. Ness & Co., Montreal. The special feature of this new instrument, which is the invention of Mr. T. W. Ness, and has been patented in Canada, the United States and other countries, is an automatic switch return, by means of which the switch is brought back automatically to its normal point after conversation is finished. Those who are familiar with the old system, in which connection is made by inserting a plug in a socket corresponding with the line desired, which plug requires to be withdrawn after through talking, but is constantly overlooked, or the old style of switch, which requires to be returned by hand to its normal point, will at once see and appreciate the value of this new invention

NESS TELEPHONE.

The automatic switch, receiver hook and bell are combined in the centre box. This automatic system is particularly suitable for connecting the different departments of factories, warehouses, offices, banks, colleges, etc., and it will be observed that no central office for making the different connections is required. Each instrument in a series has switch points corresponding or connecting with each of the other instruments, so that any one telephone can call up, or be called up, by any other by simply turning the switch lever around to the point corresponding with the instrument desired, and at the same time "ringing up," which is done by pressing the lever down upon the outer ring, shown below the switch points; this causes the bell of the instrument required to ring. After conversation is finished, the hanging up of the receiver causes the switch lever to return automatically to its own point, thus leaving the telephone in position to be called up by any other instrument. When desired, the instruments can be so arranged that only certain ones in a series can call up certain others, instead of having the whole system interchangeable. In ringing up, only the bell of the instrument required sounds, so none of the others are disturbed, and conversation is at the same time private. In a series of, say, eight instruments, 1 and 3, 2 and 4, 5 and 6, might converse at the same time, without interfering with one another.

A New Transformer.

In the transformer which we illustrate, manufactured by the New York and Ohio Company, Warren, O., an attempt has been made to incorporate all of the improvements of the

AN IMPROVED TRANSFORMER.

past few years in transformer construction, and at the same time to avoid the mistakes which have naturally been made in many cases in attempting to secure desirable but hitherto unattained results. The efforts of the manufacturers from the start have been to produce, not a transformer that can be easily repaired, but one that will not require such repairs, and hence in which the feature of cheap repairs ceases to be of any value. Severe tests covering this point have shown almost conclusively that the Packard transformer, by which name it is known, cannot be burned out under anywhere near normal conditions. The importance of attaining the result is evident, providing, of course, that no sacrifice has been made in other directions. It will be readily believed that no such sacrifice has been necessary, as perfect insulation does not conflict in any way with high efficiency or perfect regulation, but is rather an assistance to it. Careful tests, extending over a considerable period of time, have besides demonstrated the attainment of the highest results as regards efficiency and regulation.

By reference to the cut of the transformer it will be observed that in mechanical construction it is neat and compact, showing that careful consideration has been given to general detail. The fusing arrangement is convenient and complete; throwing back the two round covers or lids shown in the cut discloses two porcelain plugs, which carry the transformer fuses, which can be withdrawn and re-fused or another plug inserted almost instantly without the use of any tools or the least danger to the operator.

In the construction of the coils the only theoretically correct form has been followed, that is the circular, or ring, form,

and care has been taken to proportion the windings so that the best possible results will be secured. The point in which the superiority of the Packard transformer undoubtedly lies, however, is in the insulation of the transformer coils. By a new system of insulating transformer windings the manufacturers have been able to make a transformer that cannot burn out under ordinary conditions.

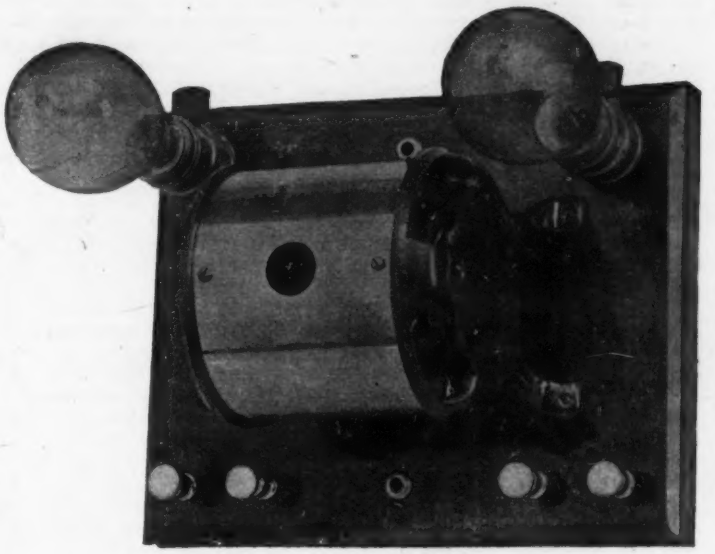
In the manufacture of the transformer every detail of the work is done only by experienced, expert help, and no expense is spared to make a perfect machine in every respect. The fact that the transformer, as its name indicates, is manufactured entirely under the personal supervision of Messrs. J. W. & W. D. Packard, the manufacturers of the celebrated Packard lamp, is a sufficient guarantee that nothing is spared to make every transformer that leaves the factory as perfect as money, long experience and skilled labor can make it.

Acoustic Synchronizer for Alternating Machines.

With the great use of alternating current machines and with our modern ideas of central station practice, it is frequently desirable to run alternators—single-phased and polyphased—in parallel. Although alternators have not hitherto been run in parallel as a general thing on this side, the practice is not infrequent in Europe, where it has been made the subject of much study. The operation of alternators in parallel is, however, receiving more attention here, and a device to indicate in the most delicate, yet effective manner, the exact point of synchronism in speed and coincidence of phase of two alternators has become a necessity. The requirement is met by the acoustic synchronizer, which the General Electric Company has recently brought out. It consists merely of a cylindrical iron case with an aperture in the side, each end being closed by flexible diaphragms, each of which has opposite its centre, the pole of an electromagnet. In using this device one of the magnets is connected in circuit through a transformer, with each of the machines to be run in synchronism. The current is then turned into the magnet coils, and the diaphragms emit a loud, clear note. As the machines approach synchronism the notes from the diaphragms approach closer in period and begin that loud, periodic sound, known in music as beats. As the two machines more nearly approach synchronous speed the beats grow slower and slower until finally the diaphragms fall into unison, and each gives out the same low, clear note. At this moment, which is sharply marked, the switch connecting the two machines should be thrown in. So sensitive and distinct is the indication of approach of synchronism, that it is possible to throw two machines together with hardly a quiver upon the ammeter in actual circuit.

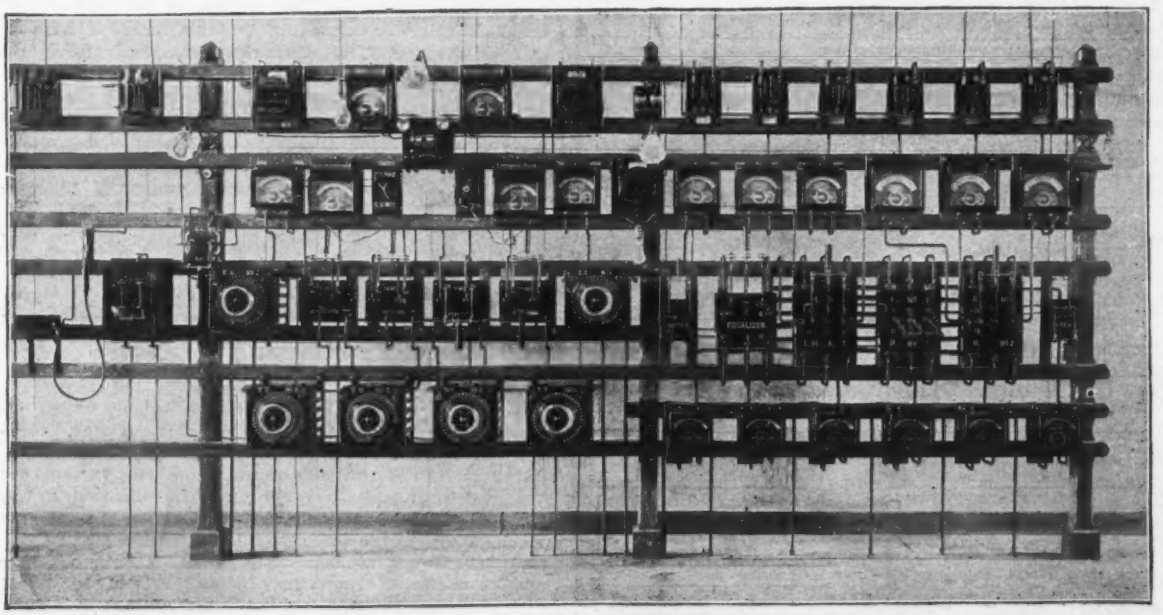
The immense superiority of this acoustic apparatus over the old phase lamp device cannot be disputed. It is much more sensitive, indicating distinctly the small differences from synchronism, which the phase lamp fails to detect.

The synchronizer was shown by the General Electric Company in its power and mining department at the Chicago Exposition, where it attracted considerable attention, especially from foreign electricians. When it was shown to Prof. Von Helmholtz and its operation explained, he expressed himself delighted. It was a development in his own field of acoustics and showed how electricity and acoustics could work together for scientific benefit.



ACOUSTIC SYNCHRONIZER.

In our issue of Dec. 2, 1893, we described fully the three-phase power transmission plant installed by the General Electric Company, at Redlands, Cal. We are now able to show the switchboard fitted up with its different regulating and controlling apparatus. The synchronizer, which the irreverent Californians have labelled the "growler," is shown in the upper left-hand portion of the board.



SWITCHBOARD IN THE REDLANDS STATION.

Financial Intelligence.

The Electrical Stock Market.

New York, Jan. 15, 1894.

THE ELECTRICAL STOCK MARKET has experienced another week of comparative dullness and light trading. Though one of the electric stocks was active on particular days, and advanced several points, the other electrical stocks, both listed and unlisted, remained stationary with no transactions. Purchasers of indus trial securities are still holding off until the financial situation becomes more settled. The report in Wall Street that the New York banks would furnish no more gold for export, leaving all drains to be made on the Sub-Treasury, and the expected bond issue at Washington, makes the money market very uncertain. Everyone looks for a turn in the tide but it does not seem to come.

GENERAL ELECTRIC STOCK closed several points higher today than it did a week ago, and the stock is probably at present stronger than it has been for two weeks. As most of the industrials made slight advances, General Electric did also, but the greatest gain was made on receipt of the news of Judge Shipman's decision favorable to the General Electric Company, and against the Novak lamp. This shows what an effect patent litigation has in Wall Stret. This decision is a sort of prop in the company's fast failing monopoly in the lamp business and the stock profited thereby. Another thing which gave the security a little boom, was good news from Boston. It was that the annual report of the General Electric Company would show a reduction of the floating debt, including indorsed bills receivable, of from $12,000,000 to $1,000,000, and also by the removal of the general offices from New York to Schenectady, there would be a saving of $40,000 in taxes. These are sweeping figures and of course must at present be relegated to current rumor. But the removal of the offices to Schenectady, and the present economical ways of the company, certainly put the concern in a better attitude. That commercial houses are still sceptical of its finances is shown by a story current in Wall Street that R. G. Dunn & Company had made inquiries into the General Electric Company's affairs and had then refused to rate them. This report will as yet have to be spoken of as gossip. When the annual report of the company is made public and the policy and management of the concern is shown to be on a thoroughly business basis, the stock may recover from its low figure. It is now quoted at 36½.

THE STREET RAILWAY AND ILLUMINATING PROPERTIES, of Boston have declared a dividend of 6 per cent. on the preferred shares, payable Feb. 1. The payment will be made at the office of the Old Colony Trust Company by the transfer agent to holders of record at the close of business Jan. 18. The transfer books close from Jan. 19 to Feb. 1. As this concern is the trust formed to underwrite and liquidate the General Electric Company's floating debt, it has apparently made enough money out of the transaction to declare a dividend.

ALL OTHER ELECTRICAL SECURITIES have not made any changes during the week and the prospects are not bright for immediate trading in them.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
Cleveland General Electric Co.	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref.	15	15	16
" " " com.	15	15	17½
Edison Electric Ill., New York	100	96	99
" " " 1sts	—	103	104
Edison Electric Ill., Brooklyn	100	99	102
" " " Boston	100	115	120
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	—	2½	5
" Bonds	—	80	85
" Ore Milling	—	5	12
Fort Wayne Electric	—	5	9
General Electric Company	100	36¼	36½
" " " deb. 5's	—	71	72
Interior Conduit and Ins. Co.	100	25	35
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	41	43
" " " pref.	50	23½	24½
Western Union Telegraph	—	84¾	84⅞

New Incorporations.

THE NEW YORK STATE ELECTRIC COMPANY, Canisteo, N. Y., capital stock $25,000, has been formed to manufacture electrical supplies. C. House, M. Ekstromer, and Peter Hanlon, Canisteo, N. Y., are the incorporators.

THE OAKLAND RAILROAD COMPANY, San Francisco, Cal., capital stock $2,500,000, has been formed to build and operate a railroad between Oakland and Berkley, by electricity, or some other means. C. F. Crocker, H. E. Huntington, C. E. Green, F. S. Doty, San Francisco; and S. T. Gage, Oakland, Cal., are the promoters.

INTER-URBAN ELECTRIC RAILWAY COMPANY, La Salle, Ill., capital stock $250,000, has been formed to purchase, construct and operate street and inter-urban railways, with all the appliances and appurtenances incident to or connected therewith, including the power in connection with the railway to purchase and construct electric light and power plants. C. W. Palmer, R. M. Gardner and M. C. Van Fleet are the promoters.

Special Correspondence.

New England Notes.

Branch Office of the Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Jan. 13, 1894.

THE MASSACHUSETTS MUTUAL FIRE INSURANCE COMPANY'S new Board of Directors have organized with Chas. B. Cumings as president and treasurer, and John M. Corbett as secretary.

THE BOSTON COMMON COUNCIL has passed an order that a joint special committee be appointed to consider and report on the subject of having all electrical wires and cables operated underground in the city.

MUNICIPAL ELECTRICITY.—Representative Hathaway, of Brockton, has a bill which he will ask the Legislature to enact to authorize cities and towns to establish and operate electric light and gas plants. The bill provides that the cost shall not exceed 5 per cent. of the valuation of towns, and 2½ per cent. of that of cities. The question of the municipalities engaging in the business is to be submitted to the vote of the people. The proposed new law is different from the present one in that the gas or electricity may be used for heat and power as well as for light.

Pittsburgh Notes.

Pittsburgh, Jan. 13, 1894.

THE MONONGAHELA ELECTRIC LIGHT AND POWER COMPANY, of Homestead, Pa., has gone into the hands of a receiver, Mr. S. A. Duncan was yesterday appointed receiver upon petitions of the company to the court to prevent a sale and consequent sacrifice of the company's assets by creditors pushing their claims.

THE STANDARD UNDERGROUND CABLE COMPANY, of this city, a few days ago declared its regular quarterly dividend of 1½ per cent. and at the same time gave out a report as to the operations of the company during last year. According to this it appears that orders were taken amounting to $628,000. At the beginning of the year unfilled orders to the amount of $100,000 were on hand, which brings the business up to $725,000. The net earnings of the year are estimated at $130,000, which is 12 per cent. on the capital stock, and an increase over the earnings of 1892 of $40,000. The annual meeting of the company will take place some time this month.

IN THESE DAYS of general depression it is gratifying to note the constantly increasing business of the Westinghouse Electric and Manufacturing Company. While the output of the company for last November was $500,000, for December it was $550,000. The company has on hand a large number of unfilled orders which will keep the works running to their full capacity, and a considerable night force will be put on immediately to keep the large tools in operation on the Niagara Falls contract, and in the manufacture of other large generators for which the company has received orders.

THE WESTINGHOUSE MACHINE COMPANY held an adjourned annual meeting last Tuesday, and the following directors were elected: George Westinghouse, jr., H. H. Westinghouse, John Caldwell, E. E. Keller and D. E. Jackman, Upon organization of the board, the following officers were elected: George Westinghouse, jr., president; E. E. Keller, vice-president and general manager; D. E. Jackman, secretary and treasurer. Mr. E. E. Keller is the gentleman who was formerly connected with the Westinghouse Electric and Manufacturing Company, and it was he who had charge of the work the company did at the World's Fair. It is understood that in the future the Machine Company and the Electric Company will give especial attention to the manufacture of combined dynamos and engines. A complete line of new dynamos for D. C. and A. C., it is said, have already been designed for the various sizes of compound engines manufactured by the Machine Company.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building, Chicago, Jan. 13, 1894.

THE METROPOLITAN ELECTRIC COMPANY is moving into its new building, 186-188 Fifth avenue, Chicago, Ill., where it will have ample store and office facilities, besides warerooms, and is

putting in a large line of staple goods to enable them to take care of all orders without delay.

GEORGE G. CARTER & CO., No. 1,563 Monadnock Block, has recently obtained a large order for Habirshaw wires and cables from Louis K. Comstock, to be used in the electric installation in the Champlain Building, now erecting at the corner of State and Madison streets, Chicago. The Habirshaw wire used in this building will be specially prepared for plaster work. The company has also recently received a large order for incandescent lamps from a large plant in the East, and feels that the prospects for business are brightening, although its business thus far has not warranted any complaint, notwithstanding the prevailing depression.

News of the Week.

Electric Light and Power.

TRENTON, NEB., is discussing the electric light.

ENFIELD, N. H., is talking of putting in electric lights.

BAKER CITY, ORE., is considering the question of granting an electric light franchise.

ELKHART, IND.—The Council recommends that the city establish a municipal electric lighting plant.

READING. PA.—The Police Committee has been authorized to call for bids for lighting the streets and City Hall.

EVERETT, MASS.—A resolution has been adopted in favor of establishing an electric light plant by the city of Everett.

KEARNY, N. J., has sent a bill to the Legislature empowering the township to issue bonds for an electric lighting plant.

EAST ORANGE, N. J.—The East Orange Township Committee calls for bids for electric street lighting for a period of ten years.

JOPLIN, MO.—The present street lighting contract has expired, and the Council will now let the contract for a five-year period.

THE SAN MARCOS (TEX.) ELECTRIC LIGHT AND POWER COMPANY will increase its capital to $20,000 for improvements.

WILLIAMSPORT, IND., is to have the electric light soon. H. P. Hill & Co., of Evansville, has been awarded the contract.

HERMANN, MO.—Messrs. Herzog, Kropp, Graf and Wenzel are interested in a projected town lighting plant.

MORRIS PLAINS, N. J.—The electric light will be introduced in the hospital here and at Trenton.

BUFFALO, N. Y.—The General Electric Company, now on Court street, proposes to build a large plant on Wilkeson street.

LAUREL, MD.—The Laurel Electric Light Company proposes to change its motive power from steam to water power.

FAYETTE, IOWA.—The Town Council will soon take definite action in the matter of the proposed electric lighting plant.

SCHENECTADY, N. Y.—The contract for lighting the city has been awarded to the Schenectady Illuminating Company.

DALTON, MASS.—The Northampton, Mass., "Herald," is authority for the statement that an electric plant will be built in Dalton in the spring.

JERSEY CITY, N. J.—The Hudson County Board of Freeholders has adopted plans and specifications for the proposed electric light station at Snake Hill.

EVERETT, MASS.—At the last regular meeting of the Mayor and Aldermen a resolution was adopted in favor of establishing a municipal electric light plant.

THE CARO (MICH.) ELECTRIC LIGHT WORKS are in the market for more alternating dynamo capacity, one voltmeter and general supplies from time to time.

BATAVIA, N. Y.—The Consolidated Gas and Electric Light Company is considering the feasibility of establishing a motor circuit when its light contract with the village expires.

MILWAUKEE, WIS.—Captain Pabst has been granted an electric light franchise in the Second, Third, Fourth and Seventh Wards.

ELKHART, IND.—The City Council has passed the following resolution: "That it is the sense of the Council that the city should own and operate its own electric light plant."

ALEXANDRIA, VA.—There is trouble with the plant of the street lighting system, and the general opinion seems to be that a new engine is necessary.

BATAVIA, N. Y.—Official proposals have been called for by the Trustees of Batavia for furnishing an electric lighting plant, dynamos, etc., to be received until 8 p. m. on Jan. 24.

ARCHBALD, PA.—The Borough of Archbald will enter into a contract with the Crescent Electric Company for lighting the streets of the borough by electricity.

COLLINGSWOOD, N. J.—The Collingswood Water and Light Company is the possessor of a lighting franchise and is desirous of putting electric lights into the borough as soon as expedient.

ANNAPOLIS, MD.—The City Clerk has been directed to call for bids for lighting the city for three or five years with electric light and gas.

GEORGETOWN, TEX.—Plans and specifications have been prepared for the proposed municipal electric lighting plant by Wm. P. Rounds, and bids will soon be called for.

SHICKSHINNY, LUZERNE COUNTY, PA.—Residents of Shickshinny will vote in February the matter of issuing bonds to the amount of $8,000 to pay for an electric light plant.

DES MOINES, IOWA.—Sealed proposals will be received to Jan. 23 by the Board of Public Works for lighting the streets and alleys for one year with 200 or more arc lights. R. S. Finkbine and R. L. Chase are the Board of Public Works.

MORRIS PLAINS, N. J.—The Board of Managers of the Trenton and Morris Plains Hospital have decided to place electric lighting plants in the hospitals in place of the present gasoline system.

IOWA CITY, IOWA.—The contract for lighting the city for the next five years has been awarded to the Iowa City Electric Light Company. The contract provides for 35 lights instead of 15 as formerly.

GERMANTOWN, PA.—Residents of Chestnut Hill want electric lights. It is contended that were a good man to take hold of the project, enough capitalists could be induced to enter into the scheme to form a stock company and erect a plant.

RICHMOND, IND.—The proposed municipal plant was voted down and a ten-year contract awarded to the Richmond Light, Heat and Power Company, composed of Dayton, Ohio, capitalists. The general sentiment is against this action of the Council.

THE LOUISIANA (MO.) ELECTRIC LIGHT COMPANY has passed into the hands of the Carbon Light Company, of which B. S. Reynolds is superintendent. Extensive improvements are being made, including a 170-h. p. Porter-Allen engine, and additional dynamos and a battery of new boilers.

THE HEALDSBURG ELECTRIC LIGHT AND POWER COMPANY, San Francisco, Cal., capital stock $25,000, has been formed to construct electric plants, etc.; A. H. Babcock, B. R. Babcock, D. H. Ward, J. T. Ward, and A. S. Ward, Oakland, Cal., are interested.

DETROIT, MICH.—Sealed proposals will be received to Jan. 30 for labor and materials for necessary engines, boilers, dynamos, etc., for the proposed public lighting plant, as per specifications on file in the office of the Public Lighting Commission. Will. F. Conant, 511 Hammond Building, is secretary.

PATERSON, N. J.—The proposed $300,000 electric lighting plant, to be operated by the authorities of Paterson, is meeting with strong opposition from prominent citizens. The Hon. George A. Hobart, president of the Passaic Water Company, is leader of the opposition.

LINWOOD, OHIO.—Sealed proposals will be received to Jan. 23 by the Board of Waterworks and Electric Light Trustees of Linwood for the erection of the primary feeders for the incandescent light system for the village, as per details to be had at the office of George Hornung, 30 East 4th street, Cincinnati, Ohio.

OMAHA, NEB.—The Omaha "Bee" reports that $50,000 will be spent for improvements by the Electric Light, Heat and Power Company. The improvements will be new boilers and engines and incandescent dynamos, a power circuit, and the replacing of many of the old lines.

TOWSON, MD.—James McEvoy, William Lanahan, John A. Worley, William S. Paca and John Paca, have filed a certificate with the County Clerk for incorporation of the Suburban Electric Light and Power Company, of Baltimore County, to furnish light, heat and power.

MEADVILLE, PA.—A resolution has been adopted authorizing the authorities to engage an expert electrician to inspect and report on the condition of the city's electric lighting plant. The city clerk has been authorized to call for bids for repairing the electric lighting dynamo.

PLAINFIELD, N. J.—After some discussion in the matter of electric lighting contracts, for which the local Plainfield electric company and the Edison Electric Light Company are bidding, it was decided to refer the matter to the Committee on Fire, Water and Lamps.

GENEVA, N. Y.—The electric light station at Geneva is now in the hands of the new company. The street railway is an assured fact, as the Brush Company is under contract to furnish engine, boiler, dynamo, switchboard and four cars. Work will begin as soon as the frost is out of the ground.

AUGUSTA, GA., is desirous of having a large electric power plant installed to furnish power, from its excellent waterfalls, all over the city, to shops and factories. There is an electric power plant in operation, but its charges for power are $60 per h. p. per annum. With a specially built electric power plant, the cheap water-power should enable electric power to be furnished at less than $25 per h. p. per annum.

THE AUDUBON, IA., "Republican" says that the electric light plant in that city is a paying institution, and a net profit every

Library of

month is being appropriated to the payment of the debt. This plant is owned by the city and was put in operation about two years ago. The fact that it is paying a good profit over and above expenses is sufficient evidence that it is best for corporations to own and operate their own electric light plants.

SAVANNAH, GA.—The Brush Electric Light and Power Company, of Savannah, Ga., held their annual stockholders' meeting on Jan. 11. President S. P. Hamilton and all the old directors were re-elected, and three new directors added: Messrs. J. S. Collins, W. K. Wilkinson, and W. W. Mackall, which increases the Board to twelve in number. The company is in excellent condition and is soon to make some changes and additions to its plant. It is intended to consolidate the station and apparatus of the former People's Light and Power Company (which was united with the Brush Company several months ago) with the Brush Company's station, making one central lighting and power plant.

CLEVELAND, OHIO.—A committee of the City Council has recommended that the Corporation Counsel be instructed to draft a bill to be submitted to the Legislature requesting authority for the city to issue bonds in the sum not exceeding $750,000, for the purpose of establishing a public electric light plant. This is the result of an investigation of alleged overcharges by the local electric lighting company. The committee further finds from the evidence submitted by expert electricians, that were the plant constructed under the latest improved methods, electricity could easily be furnished to the consumers at the price of 7 cents per thousand watt hours; but that the General Electric Light Company's plant is constructed in such manner that a reasonable and fair price would be 9 cents per thousand watt-hours, which price it recommends they be permitted by ordinance to charge. Testimony of expert electricians leads the committee to conclude that it would be possible and proper for the city, at a cost of $600,000 or $750,000 at the most, to erect a plant which would supply arc lights upon every street intersection in the city and about 15,000 incandescent lights, at a cost of 7 cents per thousand watt-hours to the city and consumers, and pay such dividends upon the investment as to make the plant pay for itself in fifteen to twenty years.

The Electric Railway.

POMONO, CAL.—A franchise has been granted C. G. Baldwin to construct an electric railway to Chino and Ontario.

BABYLON, L. I., N. Y.—A company is being formed to connect Babylon with Brentwood and other nearby places.

PORSTMOUTH, OHIO.—The City Council has sold the electric light plant to the Portsmouth Street Railway Company.

PHILADELPHIA, PA.—The directors of the Hestonville Railway Company have decided to trolley the road at a cost of $1,200,000.

ORLANDO, FLA.—R. E. Green is interested in the proposed electric road to be built by the Orlando Street Railway Company.

SALT LAKE CITY, UTAH.—The City Council has granted a franchise to H. M. McCartney for an electric or cable street car line.

BURLINGTON. VT.—An electric road to connect Hinsburg and Burlington, Vt., by way of Shelburne, is being talked of in that section.

SUNBURY, PA.—The electric line of the Sunbury and Northumberland Street Railroad Company is to be extended to East Sunbury.

HYDE PARK, MASS.—It is stated on good authority that the West End Electric Street Railway lines will extend in the spring to Mount Hope.

BENTON HARBOR, MICH.—C. P. Wright, president of the new Lake Shore electric railway, is securing right of way from St. Joseph to Stevensville.

LOS ANGELES, CAL.—E. L. Clark, of the Consolidated Street Railway Company, states that work will soon be commenced on the proposed line to Pasadena.

WHITE PLAINS, N. Y.—The following are the committee in the matter of the proposed electric railway: Christopher Harmon, John T. Rehill, and E. B. Long.

NEW ORLEANS, LA.—The St. Charles Street Railway Company has applied for authority to make certain extensions to its line and to use electricity as a motive power.

HOMESTEAD, PA.—J. C. Whitla, of Beaver Falls, Pa., president of the proposed Homestead Street Railway Company, states that work will begin about the 1st of April.

BINGHAMTON, N. Y.—The Binghamton Street Railway Company will extend its line from Floral avenue to the Catholic cemetery, about one mile, at a cost of $10,000.

ATLANTA, GA.—The Lithia Springs Railway Company, of Lithia Springs, in Douglas County, has secured the $300,000 necessary for the construction and equipment of the road.

MOUNDSVILLE, W. VA.—The surveying of the Benwood-Moundsville Street Railway line has been completed. W. C. Smith & Son, of Wheeling, W. Va., have charge of the work.

CAMDEN, N. J.—The trustees of the E. C. Knight estate have granted the application of the Camden Horse Railway Company for right of way for its proposed trolley through "Knight Park."

PITTSBURG, PA.—The Mayor's veto of the proposed charter for the Pittsburg and Mansfield Street Railway Company, has been sustained in Common Council by the narrow majority of one vote.

CHARLESTON, S. C.—It is stated on the best of authority that the City Railway is to be sold to a syndicate of Eastern capitalists, who will convert it into an electric line and extend and improve it.

WEST CHESTER, PA.—S. M. Patterson, president of the Pennslyvania Traction Company, announces officially that work on the new electric railway from Harrisburg to Philadelphia will be begun in the spring.

HARRISBURG, PA.—The Harrisburg "Call" contains mention of the proposed electric railway between there and Marysville, but no names are mentioned in connection therewith and no definite steps have been taken.

DAVENPORT, IOWA.—Electrician Fredericks, of the D. & R. I. Street Railway Company, has made specifications for the equipment of the bridge line with electricity, and they will be sent to Washington for approval.

NEW BEDFORD, MASS.—The Railroad Commissioner has granted permission to the Union Street Railway Company, of New Bedford, to issue $350,000 additional stock and $350,000 in bonds for use in building its proposed line.

WASHINGTON. D. C.—Vice-President Schoepf, of the Eckington and Belt Line Railroad, who is also interested in the proposed Baltimore and Washington electric road, states that the work on the latter road will commence at once.

LOOKOUT MOUNTAIN, at Chattanooga, Tenn., is to have another inclined cable railway to its summit. The new one is to run direct to the Lookout Inn. This means increased traffic for the connecting electric car lines to Chattanooga.

SOUTH NORWALK, CONN.—The Horse Railroad Company is before the Selectmen with a petition asking for approval of its proposed action to equip the Winnipauk branch with electricity. No opposition appeared, so the petition was granted.

BRIDGETON, N. J.—At a meeting held in Bridgeton a strong sentiment was manifested in favor of the proposed Bridgeton, Cedarville and Port Norris Railway Company, and there seems to be no doubt of the early commencement of work on the road.

MORRISVILLE, N. J.—The Morrisville Borough Council is now considering a petition from the Morrisville and Trenton Electric Road for a franchise for an electric road to be run as an extension of the lines of the Trenton Passenger Railway Company.

ATLANTA, GA.—A petition has been filed in the Federal Court of Atlanta, Ga., praying that a receiver be appointed for the Atlanta Consolidated Street Railway Company. The petition will be given a hearing on the 19th of January, at New Orleans, La.

ATTLEBORO, MASS.—Owing to the complicated condition of the affairs of the Attleboro, North Attleboro and Wrentham Street Railroad, President Peter Nerney has resigned, and has also tendered his resignation as a director of the Interstate Railroad.

THE NORTHWESTERN ELEVATED RAILWAY will, it is believed, undoubtedly use electricity as a motive power. From hints dropped here and there it is understood that a middle rail below the level of the wheel rails will be used to carry the electric current to connect with the motor car.

HARTFORD, CONN.—The Hartford "Telegram" states that no answer has yet been made by the company in the matter of equipping the four city lines with the trolley system, but it is reported that the Street Railway Company has met the proposition of the Common Council with a counter proposition.

CHARLOTTESVILLE, Va.—The City Council has granted the Piedmont Construction and Improvement Company a franchise to use some of the principal streets for an electric or cable railway. The members of the company have not yet been published. The franchise gives them 90 days in which to commence work.

MOHNSVILLE, PA.—It is expected that work will be commenced within two weeks on the proposed Mohnsville and Adamstown Street Railway Company. Among those interested are ex-Senator E. Billingfelt, of Adamstown; George W. Keim, of Reading; H. C. Mohn, of Adamstown, and Isaac Spatz, of Mohnsville.

BURLINGTON, VT.—A scheme is being pushed for an electric road from Burlington to Hinsburgh and Shelburne, and a meeting was held at the residence of E. N. Sanctuary, of Hinesburg, Vt., at which the Hon. Isaiah Dow, of Hinesburg, presided, and it is almost certain that the road will be built.

ROME, GA.—The Electric Street Railway Company is in the hands of a temporary receiver, Mr. John H. Reynolds being appointed. The trouble seems to be dissension among the stockholders, of whom there are only four. A hearing on the application for a permanent receiver will be given on the 15th of January.

NEW HAVEN, CONN.—The Springfield "Republican" is the

authority for the statement that the New York, New Haven and Hartford Railroad will build the proposed electric road here and color is given to the statement by the fact that Superintendent Curtis and Engineer Spencer have been in Conway looking over the ground.

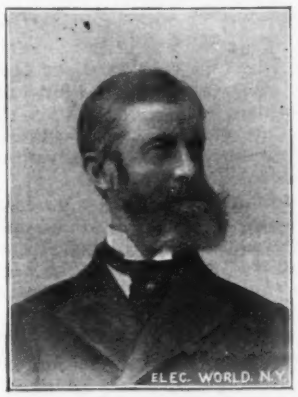
RICHMOND, VA.—Mr. Parrish, of Goochland, Va., has introduced into the Virginia Senate a bill to incorporate the Virginia Electric Railway Company, with power to erect electric plants and operate electric railroads in Richmond, Norfolk and other cities in the State.

SAVANNAH, GA.—The consolidation of the entire electric street railway interests of Savannah is probable. Mr. J. N. Harriman, of New York, who is largely interested in the combined City and Suburban and Coast Line Street Railways, has been in Savannah on a recent visit, where he held an extended conference with Mr. J. S. Collins, president of the Savannah Electric Railway Company. Mr. Harriman states that he and Mr. Collins are both willing to consolidate their two roads. Combination seems to be the word in Savannah.

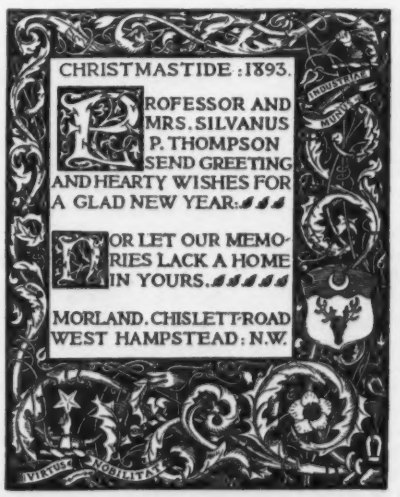
MALDEN, MASS., has passed the West End order, a matter which has occupied more attention of the 1893 Board than any other question of the year. The order gives the West End road permission to use electricity as a motive power on all its lines in Malden, from the Everett to the Medford boundaries, on Main, Pleasant, and Ferry streets. There are a large number of conditions, the principal one being a 5-cent fare from any point in Malden to Scollay square, Boston. Assurance was given the committee that the West End road would accept the conditions at once and rush the equipment as fast as possible.

Personal.

JOHN D. CRIMMINS, from his connection with New York and New Jersey electric traction enterprises and far-reaching plans for further extensions into the same field, has become an important auxiliary to the electrical industry, upon which his marked energy and broad views are already beginning to make a decided impression. Although Mr. Crimmins has not yet reached his fiftieth year, he has already a record of achievements that few men have attained in a long lifetime. As a contractor he has erected more than 400 buildings in New York, including the Lenox Lyceum, and helped build the aqueduct; he has served as a Park Commissioner for five years, is a member of the Real Estate Exchange and Chamber of Commerce, a trustee of two banks, president of a land and improvement company, trustee of several charitable and religious societies—and the father of fourteen children. Mr. Crimmins' entry into the electric railway field has been recent, and it is rumored that the idea of the $50,000 prize offered by the Metropolitan Traction Company for an economical street railway system originated with him.



PROF. SILVANUS P. THOMPSON, whose name is so familiar in this country, and whose face, we are happy to say, is not unknown to Americans, has given renewed evidence of his versality by sending to his many friends the graceful New Year's greeting which is here reproduced. In combining a pretty idea with a bit of artistic design, Professor Thompson has been especially happy and has chosen a very effective way of placing himself in touch with his wide circle of acquaintances. We feel that we are not alone in returning to Professor and Mrs. Thompson the compliments of the season, and assuring them that there is little danger that their "memories lack a home in ours."


CHRISTMASTIDE : 1893.
PROFESSOR AND MRS. SILVANUS P. THOMPSON SEND GREETING AND HEARTY WISHES FOR A GLAD NEW YEAR:
NOR LET OUR MEMORIES LACK A HOME IN YOURS.
MORLAND. CHISLETT ROAD WEST HAMPSTEAD : N.W.

MR. HORACE R. WEMPLE and Miss Nellie L. Pope, daughter of Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, are to be married on Jan. 23 at Christ Church, Elizabeth, N. J. Their many friends will join us in extending to the young couple our best wishes for their future happiness.

Legal Notes.

CONTRACTS FOR STREET LIGHTING.—The lighting of streets by electric arc lights placed above the intersections of streets is not "street work," within the statute providing that in the erection of public buildings, and in all street and sewer work, it shall be done by contract let after notice by publication. (Electric Light and Power Company v. City of San Bernardino, Supreme Court of California, 34 Pac. Rep., 819.)

INJUNCTION AGAINST INFRINGEMENT OF TELEPHONE PATENT.—The Bell telephone patent, No. 186,787, in infringed by a machine which is perhaps a decided improvement in the addition of a second magnet, giving greater intensity and energy, but which does not change the operation of the parts. The fact that a patent is about to expire is no reason for refusing an injunction against an infringer who has invested his money in the business in the fact of repeated adjudications sustaining the patent. (American Bell Telephone Company v. Brown Telephone and Telegraph Company, Circuit Court, N.D. Ill., 58 Fed. Rep., 409.)

Miscellaneous Notes.

A GENEROUS CONTRIBUTION.—The Westinghouse interests of Pittsburg have donated $10,000 to the relief fund for the unemployed in that vicinity. In addition, Mr. George Westinghouse, jr., has personally made liberal donations for the relief of families in distress at Wilmerding.

PROF. EDWIN J. HOUSTON, D.D., says the Philadelphia "Inquirer," has long been active in church work as a lay preacher, and recently delivered an address, non-sectarian in character, to the pupils of Girard College. He received his degree as a Doctor of Divinity in May last at Princeton.

DR. COTTON, who claims to have been the first person who ever applied electricity to the propulsion of cars, will give a lecture on Jan. 16, at the Church of the Messiah, Brooklyn, on the "Magnetic Telegraph," to be followed by various chemical and philosophical experiments and an exhibition of a circular road and electric engine, the one originally exhibited in 1847.

A USEFUL ALARM.—Superintendent Robinson,of the Whitman Electric Company, of Hingham, Mass., has an arrangement in his room by which a slight deflection or dying down of the brilliancy of the lights over town will ring a bell to awaken him from sleep. If anything happens at the station, the man in charge by turning down the lights an instant can ring Mr. Robinson's bell.

THE ELECTRIC LAMP IN MEDICAL USE.—Prof. Julius Friedenwald, at the Baltimore City Hospital, recently demostrated to a class of medical students the use of the incandescent lamp for diagnosing diseases of the stomach. A quart of water was introduced into a patient's stomach, which distended it and at the same time floated a small incandescent lamp that had been swallowed. The light could be plainly seen through the abdominal wall and outlined the stomach.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold its eighty-third meeting at headquarters, 12 West 31st street, New York City, on Wednesday, Jan. 17, at 8 o'clock, p.m. A paper will be presented by Louis Bell, Ph.D., of Boston, on "Practical Properties of Polyphase Apparatus," By direction of Council, the last report of the Committee on Units and Standards, will be presented for discussion, in which is proposed the provisional adoption of the terms, "gilbert," "weber," "oersted," and "gauss." The full report will be found on page 662 of the December "Transactions." The January issue of the "Transactions" will not be published until after the next meeting. Advance copies of Dr. Bell's paper will, if possible, be mailed upon application to the Secretary.

THE MASSACHUSETTS STREET RAILWAY ASSOCIATION held its regular monthly meeting and dinner at Young's Hotel, Boston, on Thursday evening, the 4th inst. The special subject for discussion was, "Electric Motors; Care of and Maintenance During Winter," Mr. Robert C. Brown, of the West End Railway Company, taking the lead in the discussion, followed by Mr. E. C. Foster, general manager of the Lynn and Boston Railroad Company; P. F. Sullivan, manager of the Lowell Street Railway Company, and Mr. E. P. Shaw, of the Haverhill and Amesbury Company, much valuable practical information being given. The subject of "Electric Heating," was also discussed briefly, Mr. Jas. F. Shaw taking the initiative and presenting the claims of the New England Heater. There was a good attendance of members, much to the gratification of President Cunningham and Secretary Butler, both of whom are doing excellent service in endeavoring to arouse a deep interest in these monthly meetings.

THE NORTHWESTERN ELECTRICAL ASSOCIATION will be in session at the Hotel Pfister, Milwaukee, Wis., commencing Jan. 17, 1894, at 2 p. m., and continuing three days. The original intention was to continue the meeting for two days, but the warm-hearted Milwaukee electricians have prevailed upon the Association to remain in session one day longer to allow the members time to visit the places of interest in the city. The Milwaukee Street Railway Company has generously placed at the dis-

posal of the Association a sufficient number of cars to convey the members to all points accessible by its lines. Among the proposed places to be visited are the Milwaukee Street Railway Company's new shops, which are perfect models; the power house of the Allis Company, the Pabst Brewing Company, the Edison Power Station, the Siemens & Halske Power Station, and the Badger Illuminating Station. On the evening of the second day a banquet will be given at the Hotel Pfister. Toasts will be responded to by prominent men in the profession, and a general good time is promised.

Trade and Industrial Notes

THE FOREST CITY ELECTRIC WORKS, Geneva, Ohio, after several months idleness, resumed with a small force last week.

JOSE ELIGIO MOSQUERO, importer of electrical supplies and apparatus, Havana, Cuba, has removed from 114 O'Reilly street to 88 Obispo street.

THE STANDARD ELECTRIC TIME COMPANY, of New Haven, Conn., has shipped to San Francisco one of its electric tower clocks, which is to be placed in the Art Emporium at the Midwinter Fair.

ATLANTA, GA.—Mr. Howard E. W. Palmer, general manager of the Southern office of the General Electric Company, has been elected director-general of the International and Southern States Exposition, to be held in Atlanta, Ga., in 1895.

THE NEW JERSEY LAMP AND BRONZE WORKS, New Brunswick, N. J., have issued a new catalogue of chandeliers, brackets, and hall lights, designed by a famous artist of France. Copies may be had upon application by the electrical trade.

H. P. HILL & CO., electrical contractors, No. 12 Arcade, Evansville, Ind., have just completed the installation of a city plant at Cannelton, Ind., and started out the new year by receiving a contract to put in a city plant at Williamsport, Ind.

THE McGAHEY BROTHERS' FOUNDRY AND MACHINE WORKS, Elkton, Md., will build a new type of engine, for which Mr. Calvert R. McGahey has just been granted letters patent. A new type of balanced valve and automatic cut-off are the features.

THE UTICA ELECTRICAL MANUFACTURING AND SUPPLY COMPANY, Utica, N. Y., has elected the following officers: W. E. Lewis, president; W. H. Cloher, jr., vice-president; and M. Jesse Brayton, secretary and treasurer. R. D. Baldwin and F. S. Ferris are the additional directors.

THE L. J. WING AND COMPANY will hold its annual meeting of shareholders for the election of directors to serve for the ensuing year and for such other business as may be brought before it at the office of the company, 243 Washington street, Jersey City, New Jersey, on Thursday, Jan. 18, 1894, at 1:30 p. m.

THE KEYSTONE ELECTRIC COMPANY, of Erie, Pa., held its annual election on Jan. 9, and elected directors as follows: Hon. J. F. Downing, Carson J. Sturgeon, Captain George Platt, J. W. Leech and J. C. Sturgeon. The directors will organize on Thursday evening. The plant is being operated full time and with a good strong force.

THE HINE & ROBERTSON COMPANY, 57 Cortlandt street, New York, by consolidation with the New York Indicator and Specialty Company, now control the "Improved Straight Line" and the "Robertson-Thompson" indicators. These instruments are now used by some of the largest concerns in the country, with most satisfactory results.

THE R. THOMAS & SON'S COMPANY, East Liverpool, Ohio, has issued a catalogue of electrical porcelains, comprising 36 large lithographed pages. The list of porcelain electric fittings made by this enterprising firm is surprisingly large, and includes almost every imaginable shape of this material that can be used in the electrical industry.

CALENDARS.—A. & J. M. Anderson, Brown Electric Company, Pettengill, Andrews Company, and Ziegler Brothers, Boston; The Commercial Cable Company and Direct United States Cable Company, New York, and J. W. Parker & Company, Philadelphia, have issued neat and artistic calendars, one of which may even be called surprisingly unique.

THE THOMSON ELECTRIC WELDING COMPANY, Lynn, Mass., has received some very good orders lately for welding dynamos from Western firms, which are to be built immediately. Recently the American Projectile Company shipped two carloads of the 50-pounder standard shells, 1,500 shells in all, about 75,000 pounds in weight, to the Brooklyn Navy Yard, where they will be distributed to the battleships of the American navy.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., reports great progress with the Packard Transformer. Two orders of nearly 1,000-lights capacity each, is the record for the past week in addition to numerous smaller orders in the past few weeks, aggregating over 1,000 lights. Reports from customers show a very high efficiency coupled with close regulation and generally satisfactory results.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., are putting the roof on a building for the United States Government at Fort Wadsworth, N. Y. The building is 41 feet wide and 231 feet long, the roof being made entirely of iron—iron trusses covered with corrugated iron. The new works of the Stanley Electric Manufacturing Company, at Pittsfield, Mass., will be built entirely of iron by the same company.

T. W. NESS & CO., Montreal, Can., have been manufacturing main line and warehouse telephones for a number of years. The large number of testimonial letters submitted from leading business houses speak well regarding the satisfaction its instruments are giving. It is understood that the firm contemplates establishing a branch in the United States, for the manufacture of its various lines of telephones.

THE PAGE BELTING COMPANY, Concord, N. H., has had reproduced the diploma of highest award which it received at the World's Fair exhibit, as well as facsimiles of the two medals also awarded to it. These will be found interesting as souvenirs of the Exposition as well as for their artistic merits, the facsimiles of the medals particularly so in view of the controversy just started in regard to them.

CHARLES A. SCHIEREN & CO., 45 Cliff street, New York, have just furnished a 55-inch perforated electric belt, three-ply, for the Lindell Street Railway Company, St. Louis, Mo., length about 150 feet. They think business is picking up somewhat in the electric line, and there seems to be increased demand for their perforated electric belting. Perforations are found to prevent air cushions and hence are more noiseless and can be run with greater slack upon the pulleys.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 44 Broad street, New York, has issued a catalogue of Lundell motors and dynamos, which is in every respect one of the most artistic and handsome trade pamphlets ever issued by any firm. The cuts of the various machines are in keeping with the typographical and artistic execution of the catalogue, and form another illustration of the unrivalled excellence of the work of Bartlett & Co., the engravers.

THE COWLES ELECTRIC SMELTING AND ALUMINUM COMPANY, of Lockport, N. Y., writes to say that there is no truth in the rumor of a consolidation between it and the Pittsburg Reduction Company. It adds that no negotiations of the kind are even pending and that the Cowles Company has no intention of moving its plant to Niagara Falls. The works at Lockport are still in operation and the company is prepared to furnish aluminium and its different alloys as heretofore.

QUEEN & CO., INCORPORATED, Philadelphia, have a line of very good commercial ammeters and voltmeters in the "magnetic vane" type, which they have manufactured in large quantities for several years. These instruments are designed for light and power plants, and when placed on a switchboard, will indicate current or potential all day long. They are mounted in handsome cases, to presnt an attractive exterior, and are dust-proof as also weather proof; at least as much so as possible, with first class switchboard instruments.

F. R. CHINNOCK has taken a pleasant office in the Central Building, 143 Liberty street, New York City, room 618, where he would be pleased to see his many friends and former customers. Mr. Chinnock will hereafter do a general electrical contracting business for the installation of complete electric and steam plants, and also act as consulting, electrical and mechanical engineer. He has started in with his usual vim and vigor, and will undoubtedly meet with his former success, as he has already several large contracts booked.

ALBERT AND J. M. ANDERSON, 289 A street, Boston, Mass., have issued a handsomely printed circular showing a few forms of Aetna railway insulators and line material in general use. A facsimile is included of a very complimentary letter from Mr. F. S. Pearson, late chief engineer of the West End Road, as follows: "I would say that the Brooklyn City Railroad Company, of Brooklyn, and the West End Street Railway Company, of Boston, have used this material in large quantities, in fact, almost exclusively for the last two years, and, so far as I have been able to see, it has given good satisfaction in every particular. I have no hesitation in recommending this line material."

JAMES HUNTER MACHINE COMPANY, of North Adams, Mass., announces to the trade that on account of increasing competition and a tendency toward lower prices, as well as to facilitate the delivery of goods, it has decided to handle exclusively and sell directly, all goods of its manufacture, which were formerly sold throughout New England and the Middle States by H. N. Bates & Co., of Boston, Mass. These goods comprise the well-known Hunter patent friction clutch pulleys and cut-off couplings, as well as power transmission machinery of every description. The company's complete new plant, equipped with all modern machinery, enables it to handle large orders and maintain a uniform high standard of excellence. It constantly keeps in stock a large line of shafting, pulleys, hangers, etc., and can fill orders at short notice. The Boston office of the company, in the Bell Telephone building, corner Milk and Oliver streets, is in charge of Mr. Richard H. Hill, a mechanical engineer of thorough training and wide experience.

THE ANSONIA ELECTRIC COMPANY announces that after

careful consideration the directors have decided to withdraw their offer of compromise made to the creditors some months since, of paying 60 cents on a dollar, and give as the reason for this decision the following: The proposition was not accepted promptly by all the creditors, and on account of this the concern has almost entirely lost the benefit of the fall trade, which in the electrical supply business is altogether the best of the year. If the compromise had been accepted at once when made, the directors believe that it could have been successfully carried out. In addition to the above, the business has become to a considerable extent disorganized in Chicago, for the reason that the assignee, by orders of the court, has been obliged to conduct the business within quite narrow limits; so that at the present time the Chicago branch is not in nearly as good shape to continue as a going business as it was at the time the proposition was first made. The directors are now considering, in the interest of a proposed reorganization, the matter of making another offer to the creditors, and if, as hoped, some financial assistance outside of the company is obtained, another proposition will be laid before the creditors. This will of necessity be lower, but it is hoped to make it in the shape of a cash offer.

THE HIGHAM ELECTRIC COMPANY, 431 Shawmut avenue, Boston, will soon place on the market an arc light sytem which promises to give interesting and important results. Prof. Hooper, of Tuft's College, reports as follows on its commercial features: "The system possesses some remarkable advantages over all other systems. I have found that with fully developed (not hissing) arcs the stability of current is maintained entirely by the action of the regulator; that 50 per cent. above the working current the 'characteristic' of the dynamo does not begin to droop; that the field magnets were far below the degree of saturation that other arc light dynamos demand; that the reaction of the armature is small, being comparable with that of 'constant potential' (incandescent) rather than arc light dynamos; that there is no destructive sparking at the brushes, either at full load or on short circuit; that at full load the resistance of the dynamo is only about 5 per cent. of that of the whole circuit; that the losses due to hysteresis, eddy currents, windage and friction of the brushes and bearings, is only about another 5 per cent. of the full load; that sections of the field magnet coils were cut in and out of circuit by the regulator without perceptible sparking at the sectional commutator; this is largely due to the small amount of wire on the field, the amount being several times less than is on other arc light machines; I feel that I can fully substantiate the claims made by the owners of this system, that they have a commercially successful arc dynamo which can be manufactured at far less cost than other arc dynamos, and at the same time, will have a commercial efficiency in the neighborhood of 15 per cent. higher than the best arc dynamos of the present day; the system is unique; being a complete departure in its mode of regulating and 'stabling' the current from all other systems of arc lighting."

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED JAN. 2, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

11,389. Reissue. ELECTRIC CONNECTION; H. Sanche, Detroit, Mich. Application filed June 20, 1892. The combination of a binding post, superposed telescopically engaged terminals, wires passed through the terminals and coiled between the same and a binder screwed down on the binding post in engagement with the adjacent terminal.

11,397. Reissue. ELECTRICAL CONNECTION; H. Sanche, Detroit, Mich. Application filed June 20, 1892. The combination of a perforated terminal piece provided with a shank, a companion piece engaged therewith, and a wire passed through the perforation in the terminal piece and coiled around its shank.

511,758. ELECTRIC MOTOR; W. A. Crodus, Chicago, Ill. Application filed Oct. 11, 1892. This comprises a field magnet consisting of sheet metal plates extending in parallel planes, a field coil extending around the plates, holes in the plates, bolts extending through the plates, and a nut adapted to fit on each end of the bolts to hold the plates together and at the same time form a guard for the field coil.

511,763. TROLLEY; W. F. Duncker, Steelton, Pa. Application filed Aug. 26, 1893. A trolley having a pulley and provided at opposite sides of the same with separate outwardly tapering conical bodies provided with spiral grooves.

511,787. SELF-CLOSING TELEGRAPH KEY; H. E. Moss, Kansas City, Mo. Application filed Aug. 21, 1893. This comprises a spring-actuating rod, one end of which is provided with an insulated handle for contact with the thumb, while the other is adapted to be held by the spring in circuit, and a slotted guide sleeve carried by the key lever through which the rod operates,

511,791. AMMETER AND VOLTMETER; J. Perry and C. E. Holland, Application filed April 6, 1893. In a measuring instrument, such as described, the combination with a magnifying spring, a lever, a piece of soft iron, a coil, and index-hand, of a regulating spring attached to a lever, and means for adjusting the tension of the regulating spring. (See illustration.)

511,821. STORAGE BATTERY SYSTEM OF DISTRIBUTION; J. Trumpy, Hagen, Germany. Application filed Aug. 1, 1893. The combination of a motor, a shaft actuating a suitable switch for including a greater or less number of cells of battery in circuit, an electromagnetic clutch adapted to connect the shaft and motor, and means for maintaining the circuit, said clutch continuous during a predetermined movement of the switch.

511,822. STORAGE BATTERY SYSTEM OF DISTRIBUTION; J. Trumpy, Hagen, Germany. Application filed Aug. 1, 1893. In a circuit changer, the combination of a supported circular conducting rail, contacts mounted thereon, but insulated therefrom, a contact-brush bridging the rail and contacts,and an arm carrying the contact-brush mounted on a spindle.

511,824. TROLLEY MECHANISM FOR ELECTRICALLY PROPELLED VEHICLES; C. H. Veeder, Lynn, Mass. Application filed Nov. 23. 1892. A trolley having an insulated wire inclosed in its pole, and extending from the trolley-wheel to insulated connections contained in its standard.

511,853. TROLLEY WIRE SUPPORT; C. T. Lee, Boston, Mass. Application filed April 15, 1893. The combination of metallic strips temporarily soldered to the ear, and of sufficient length to be bent around the conductor to hold it by the ear while permanently secured thereto.

511,862. ELECTRIC LOCOMOTIVE FOR ELEVATED TRACKS; C. H. Roberts, Nartwell, Ohio. Application filed Oct. 29, 1891. A suspended track beam provided with upper and lower track rails, in combination with upper trucks whose wheels engage the upper track rails, and lower trucks suspended from the trucks by longitudinally yielding hanger rods.

511,866. ELECTRIC ALARM FOR CANE FEEDERS; A. F. Slangerup, New Orleans, La. Application filed April 28, 1893. The combination of an endless carrier, a movable magnet mounted in juxtaposition to the carrier, and a circuit changer operated through the movement of the magnet.

511,873. ELECTRIC CIRCUIT CONTROLLER; R. Callender, Brantford, Can. Application filed April 24, 1893. A normally open circuit including a magnet having a reed armature adapted to vibrate for a determined period on a single closure of the circuit, in combination with means whereby a second circuit is closed by the reed armature at the termination of its vibratory period.

511,874. TELEPHONE EXCHANGE SYSTEM; R. Callender, Brantford, Can. Application filed March 12, 1893. An automatic telephone exchange, comprising telephone lines, signal storing mechanism, signal distributing mechanism and means for thereby uniting the lines in individual pairs.

511,875. TELEPHONE EXCHANGE SYSTEM; R. Callender, Brantford, Can. Application filed Aug. 13, 1892. A series of telephone lines each connected by two branch wires to two independent circuit breakers adapted to break the circuits of all the lines save the signalling line, in combination with electromagnetic means for controlling the movement of both circuit breakers.

511,882. TELEPHONE TRANSMITTER; S. C. Drew, Boston, Mass. Application filed Jan. 23, 1893. This comprises a diaphragm and a resistant elcctrode adapted to be placed in circuit, combined with a magnet arranged to be directly influenced by the vibrations of the diaphragm, and by its changes in form act upon and vary the resistance interposed by the electrode in the circuit.

511,883. REGISTERING APPARATUS FOR TELEPHONES; A. R. Duperu, San Francisco, Cal. Application filed Nov. 17, 1892. The combination of two telephones, the line wires permanently connecting the same, a recorder located at one of the telephones in the circuit of the line wires, a double contact switch key interposed in the line circuit for throwing an auxiliary current into the line, the auxiliary being closed by the shifting of the switch key.

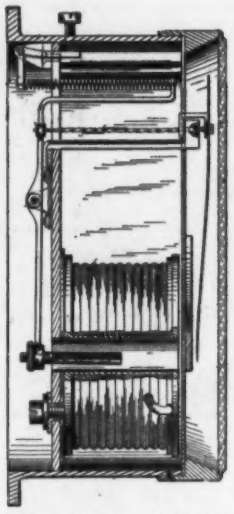
511,889. ELECTRIC SWITCH; J. L. Hinds, Syracuse, N. Y. Application filed May 16, 1892. This comprises a terminal support fixed to a base plate having a bearing opening and arms extending outwardly from the walls of the opening, a terminal mounted in the bearing opening, a clamp for drawing the arms together and securing the terminal to its support and an electric wire secured to the terminal.

511,915. ELECTRICAL TRANSMISSION OF POWER; N. Tesla, New York, N. Y. Application filed May 15, 1888. The method

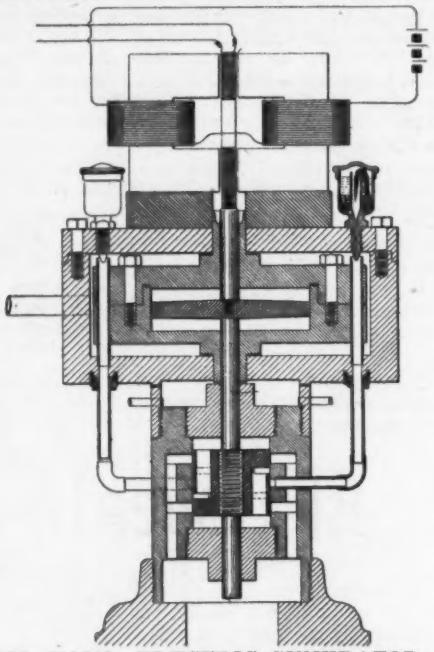
of operating electromagnetic motors having an independent energizing circuit, which consists in passing an alternating current through one of the energizing circuits and inducing by such current the current in the other energizing circuit of the motor.

511,916. ELECTRIC GENERATOR; N. Tesla, New York, N. Y. Application filed Aug. 19, 1893. The combination with a piston of a moving conductor of an electric generator in direct mechanical connection therewith. (See illustration.)

511,928. SECTION INSULATOR; H. M. Brockbank, Brooklyn,



NO. 511,791.—AMMETER AND VOLTMETER.



NO. 511,916.—ELECTRIC GENERATOR.

N. Y. Application filed Aug. 21, 1893. The combination of a strengthening strap secured to the insulator by a bolt, the bolt being provided at each end with a nut having an eye for the attachment of the span wires.

511,941. TROLLEY CATCHER; G. E. Gay and J. H. Parsons, Augusta, Me. Application filed Feb. 28, 1893. The combination of a disc having projections on one side and rigidly attached to a shaft, winding springs, a casing adapted to revolve on the shaft and a dog adapter to engage with the projection on the disc.

511,953. PUSH BUTTON; C. D. Hunking, New York, N. Y. Application filed Jan. 6, 1893. This comprises the circuit terminals a transparent opening, a pivoted index needle in or below the same, and a magnet in the circuit of the terminals to operate the needle.

511,946. ELECTRIC CLOCK; F. L. Gregory, Niagara Falls, N. Y. Application filed April 19, 1892. The combination of a vibratory clock actuating lever carrying long radius projection and a shorter radius projection, and an electrical terminal, the switch having an arm and detent rim, and a pivotally supported switch-lock having an arm.

511,988. ELECTRIC LOCOMOTIVE; E. M. Bentley, Boston, Mass. Application filed Oct. 24, 1891. This comprises a motor supported on a frame journalled on the axles of the car, the armature of the motor having a gear-wheel engaging with a pinion and journalled on a hollow bearing loosely surrounding the axle, and a flexible or yielding coupling between the gear-wheel and the axle.

512,027. REGULATOR FOR CONTINUOUS CURRENT ARC LIGHT CIRCUITS; D. Higham, Boston, Mass. Application filed May 14, 1892. The combination of a current controlling device with means for producing in a branch circuit current waves differing in phase from current waves in the main circuit and adapted to act upon the controlling device to render stable and to regulate the main current.

512,050. ELECTRICALLY CONTROLLED RAILWAY SIGNAL; F. McBrien, Newark, N. J. Application filed July 23, 1893. In a block system, the combination of a magnet in each block circuit adapted to be closed by the passage of wheels through the end of the block, a short circuit around the magnet controlled by a relay, and a track circuit governing the relay, whereby the short circuit remains closed while a train is in the block.

512,051. ELECTRICALLY CONTROLLED RAILWAY SIGNAL; F. McBrien, Newark, N. J. Application filed Sept. 25, 1893. In a railway signal, a mechanically operated signal set by a passing train, a releasing magnet for the signal, and a circuit-closer operated by the signal when set to close a circuit containing the releasing magnet, and thereby restore the signal if operated without the presence of the train.

512,055. CARTRIDGE-SHELL BATTERY; J. J. Pearson, Brooklyn, N. Y. Application filed Jan. 28, 1893. A battery formed of an outer protecting shell, a zinc lining, a silver chloride cylinder furnished with a zigzag wire for supporting the silver chloride cylinder, elastic supports for the cylinder which compensate for the expansion and contraction of the shell, electrolytic cylinder placed in the shell and surrounding the silver chloride cylinder, leaving a gas chamber and a seal for closing the end of the battery cell, formed partly of elastic material and partly of inelastic material. (See illustration.)

512,077. ELECTRICALLY CONTROLLED RAILWAY SIGNAL; J. Wayland, Newark, N. J. Application filed Oct. 5, 1893. A system comprising a plurality of blocks or sections, an automatic signal for each block, a circuit controller operated by the signal mechanism, a releasing magnet in the circuit controlled thereby, and circuit connections from the sides of the releasing magnet to the track rails.

512,102. TRANSMISSION OF RAPIDLY ALTERNATING ELECTRIC CURRENTS; W. H. Eckert, New York, N. Y. Application filed Oct. 11, 1893. This consists in generating a number of rapidly alternating currents and the transmission of such currents over a bimetallic conductor of iron or steel combined with copper.

512,115. ELECTRIC CURRENT REGULATOR; A. B. Jones, Cleveland, Ohio. Application filed June 10, 1891. This comprises adjustable magnets, an armature lever, a resistance box, movable conducting disc, the disc being supported by an arm on the armature lever, and an adjusting winding post connected with an arm of the lever.

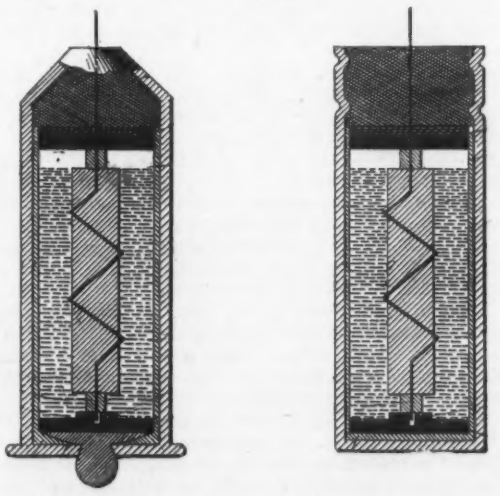
512,146. WIRE COVERING MACHINE; W. H. Avis, Toronto, Can. Application filed June 7, 1893. One or more arms carrying bobbins of yarn, in combination with a revolving spindle to which the arms are attached, and a dish containing suitable insulating compound fixed to the revolving spindle, and through which compound the strands to be covered therewith are carried.

512,201. OVERHEAD TROLLEY WIRE SWITCH; G. W. MacKenzie, M. B. Sloan, and T. C. Sloan, Beaver, Pa. Application filed Dec. 30, 1892. This comprises two arch pieces connecting the separate ends of the main and branch wires, and bridge pieces pivoted at the ends of the branch wires, and arranged to connect both ends with the main wire.

512,214. COMPOSITE TELEPHONE AND MULTIPLE TELEGRAPHIC TRANSMISSION; F. A. Pickernell, Newark, N. J. Application filed Aug. 25, 1893. The combination with the main wire of a double-wire circuit, of a retardation or choking coil in the main circuit, a condenser in an earth branch thereof, a similar coil in the artificial line and a similar condenser in the earth branch thereof.

512,217. ELECTRIC CALL; P. M. Randall, Concord, N. H. Application filed May 6, 1893. The combination of a clock, a circuit-closing commutator consisting of an insulating disc with an opening allowing the clock hands to protrude, and a plurality of holes in radially arranged pairs, and a wire passing out through one and back through the other, of each pair of holes, to form commutator bars.

512,227. REGULATOR FOR DYNAMO ELECTRIC MACHINES; C. E. Scribner, Chicago, Ill. Application filed Dec. 29, 1887. A



NO. 512,055.—CARTRIDGE SHELL BATTERY.

method of regulating the current supplied to a working circuit, which consists in changing coils of the field magnets from a shunt to a series relation with the working circuit, and vice versa; whereby the strength of the field magnets is changed.

512,250. ELECTRIC INDICATOR; A. H. Hoyt, Manchester, N. H. Application filed March 15, 1893. The combination of a pointer and its arbor with a movable bearing piece or presser, a spring arm, and knob, for actuating the same,

512,253. SECONDARY BATTERY; W. C. Lockwood, New York, N. Y. Application filed Aug. 6, 1892. A method of constructing electrodes for storage batteries, consisting in depositing metallic tin in a spongy or flocculent state from a solution of chloride of sodium and chloride of tin, by electrolytic action.